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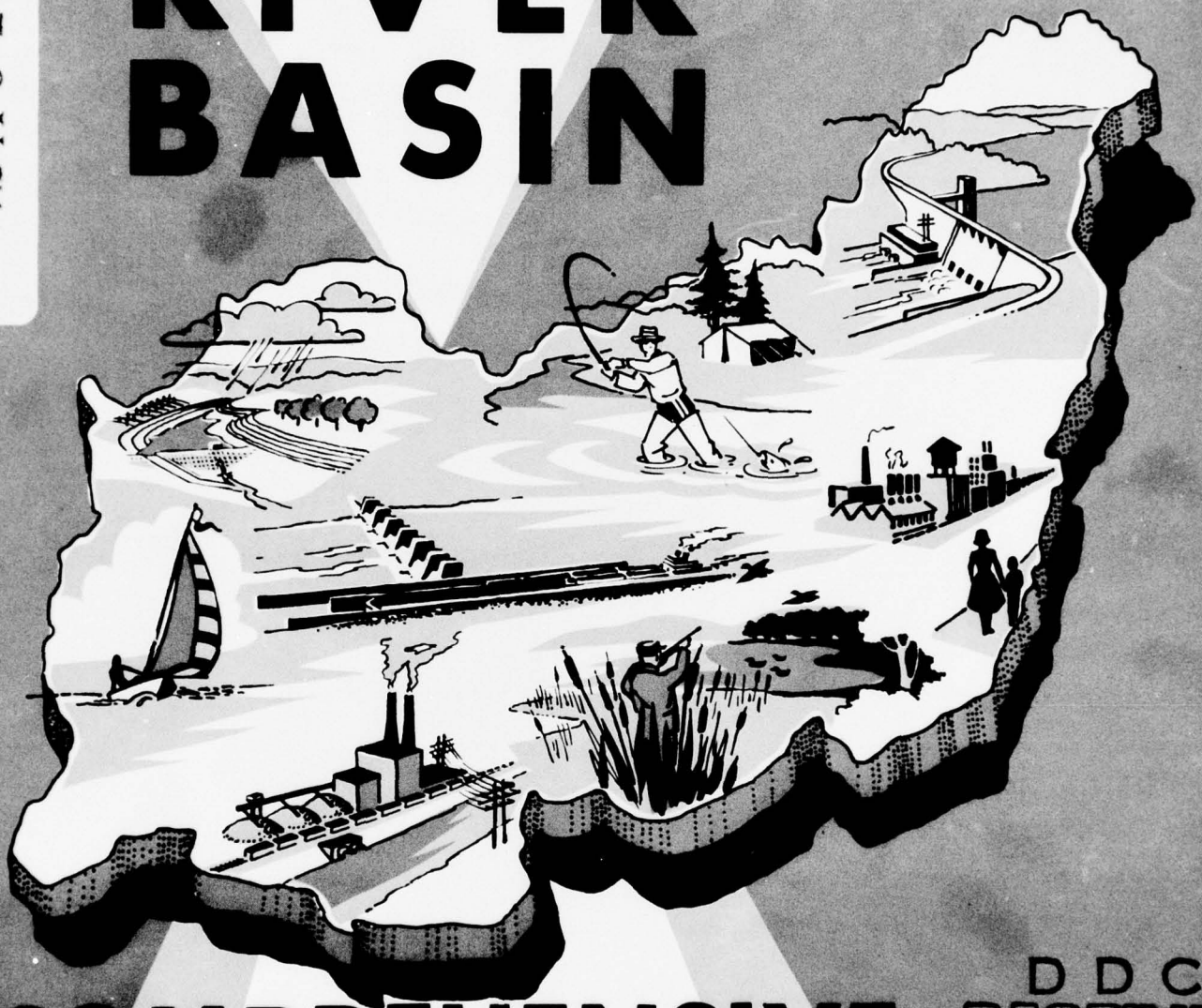
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VOLUME III

OHIO RIVER BASIN



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PROJECTIVE ECONOMIC STUDY OF THE OHIO RIVER BASIN

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APPENDIX B
OHIO RIVER BASIN COMPREHENSIVE SURVEY

Volume III.
Appendix B.

Prepared for

The Corps of Engineers
U.S. Army Engineer Division, Ohio River
Cincinnati, Ohio

(11) August 1964

(12) 436p.

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PREFACE

This report, The Projective Economic Study of the Ohio River Basin, is the basic economic portion of a comprehensive study of the water and related land resources of the Ohio River Basin. The Study being prepared cooperatively by the Corps of Engineers, interested Federal agencies, and States within the Basin will be completed by 1967. However, because of the interest shown in the Projective Economic Study by planning groups and university and business interests serving the 20 million people in the Ohio River area, it became apparent that this study should be made available now for wide distribution to the public. Therefore, this "Appendix B" is being published and made available for distribution through the Superintendent of Documents, Washington, D.C.

Other appendices to the Comprehensive Study of the Ohio River Basin will contain technical engineering data, economic evaluation of the water and land resources and other background information. Because these are expected to have only a limited technical audience, they will not be published for general distribution.

The Main Report summarizing the results of the Study will be published after completion in 1967.

W. P. LEBER
Brigadier General, USA
Division Engineer

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August 25, 1964

General W. P. Leber
Division Engineer
U.S. Army Engineer Division, Ohio River
P. O. Box 1159
Cincinnati, Ohio 45201

Dear General Leber:

I am pleased to present our report, A Projective Economic Study of the Ohio River Basin. It is designed to provide basic economic guides and benchmarks for use in the Corps of Engineers' and the cooperating federal and state agencies' comprehensive studies of water requirements and resource development possibilities of one of the major river basins in the United States. We have simulated the probable economic growth of this vast region which contains one-tenth of the Nation's population, and have used an economic activity model to express the interrelationships of the regional and national economy for a 50-year projection horizon.

We greatly appreciate the opportunity that the Corps provided by giving us this challenging assignment. The methods of regional economics have advanced rapidly in recent years, but the application of quantitative techniques to the solution of empirical problems of planning and development still lags far behind the refinements in methodology. It was with great satisfaction, therefore, that we accepted the Corps' encouragement to experiment with the more sophisticated techniques of regional economic analysis in the development of a projection framework for the Ohio River Basin study. The challenge proved to be two-fold: first, we realized that if a 50-year projection were to be useful as a planning tool for an agency charged with the construction of major public works, its structure should be flexible enough so that the projective study can be repeated at regular time intervals, when new data become available and new assumptions about the behavior of the national economy are posited. Second, our study area constituted a region encompassing parts of 10 states and almost 400 counties, for which historical statistical data were not available in adequate detail, comparability, and time span. The method which we developed had to be adapted to these severe data limitations without sacrificing internal consistency or the opportunity to substitute "better" data as they become available in the future.

In the progress of our work we consulted with a number of academic economists. Dr. Roland Artle, of the University of California in Berkeley, should be singled out for his major conceptual contribution to this project. We have also benefited from the assistance and critique of the federal and state agencies which have reviewed a draft of this report. The responsibility for its contents, however, is ours alone.

On behalf of the professional staff who conducted this 2-year study, I wish to express our thanks for your confidence in our organization.

Yours very truly,

Howard O. McMahon

Howard O. McMahon
President

ACKNOWLEDGMENTS

This study was carried out by the Regional Economics staff of Arthur D. Little, Inc. The core team consisted of A. George Gols, Senior Project Economist, Kirkor Bozdogan, Laurel Lunt, and Anne Sheehan. Peter M. Stern had over-all responsibility for the project. The team was supported by Stanley Warner, Polyvios Vintiades (computer solution of econometric model), Lindsey Lawrence (computer programming), and by ADL's industry specialists.

We wish to acknowledge the contribution of Professor Roland Artle (University of California) in designing the methodological framework. Professor C. L. Christenson (Indiana University) prepared a study of operating changes in the coal mines of the Ohio River Basin specifically for this project. A special tabulation of the 1958 Census of Manufactures for the Basin area was made by the Bureau of the Census at the request of Arthur D. Little, Inc.

The project team also acknowledges the support given by Messrs. Amos Finkbine and Ray Lanier of the Corps of Engineers' Ohio River Division, and the encouragement received from Mr. Nat Back in the Office of the Chief of Engineers, Washington, D. C.

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CHAPTER I

INTRODUCTION

This report presents the results of a projective economic survey of the Ohio River Basin designed to furnish guides for appraising future growth in relation to water requirements. The long-term demographic and economic projections produced by this study are to be used in planning the comprehensive development of the Basin's water and related land resources, so that emerging needs can be met in a timely and efficient manner. This survey thus constitutes a basic building block for one of the so-called framework studies of the country's major river basins. As such, it is meant to set quantitative benchmarks or guides for a series of more detailed field surveys of individual tributary drainage areas of the Ohio River Basin which will follow and complement the framework study.

A. THE STUDY AREA

For the purpose of this study, the Ohio River Basin was defined as the drainage area of the Ohio River and its tributaries, excluding the Tennessee River Basin, delineated along county lines approximating the physical boundaries of the watershed. Covering about 163,000 square miles, the Ohio River Basin includes the major portion of the states of Indiana, Ohio, Kentucky, and West Virginia; substantial parts of Pennsylvania, Illinois and Tennessee; and small areas of Maryland, Virginia and North Carolina. Physiographically, it lies within the deeply dissected Appalachian Plateau with its entrenched river valleys and the extensive bituminous coal fields of West Virginia and Pennsylvania; the lower tablelands of Kentucky and Tennessee, known as the Highland Rim, which also contain the fertile blue grass plains around Lexington and Nashville; and the eastern part of the Central Lowlands covering western Ohio, most of Indiana and Illinois with glacial till deposited by the continental ice sheet which once penetrated as far south as the middle and lower Ohio River.

The Ohio River Basin, as delineated for this study, also cuts across several major economic regions of the United States, as defined by Bogue and Beale.* The northeastern part of the Basin falls into the so-called Lower Great Lakes Region, which the authors characterize as one with a very high degree of urbanization and metropolitanization and heavy emphasis on manufacturing, particularly the production of durable goods and steel.

*Donald J. Bogue and Calvin L. Beale, Economic Areas of the United States, the Free Press, Glencoe, Illinois, 1961.

Bogue assigns the southern and southeastern portions of the Ohio River Basin to his Central and Eastern Upland Region, which is characterized by "a high proportion of hilly land, high human fertility, high outmigration of people, lower-than-average population growth, relatively great importance of mining, large number of small-scale or part-time farms, and a large number of small and medium sized cities having a chronically high unemployment problem." *

The remainder of the Ohio River Basin, i.e., western Ohio, most of Indiana, and eastern Illinois, is allocated by Bogue to the North Center (Corn Belt) Region, which encompasses the country's bread-basket and also contains important machinery and fabricated metal products manufacturing complexes. The growth of major metropolitan concentrations in this Region has accompanied the westward expansion of the U.S. manufacturing belt across the northern half of Ohio, Indiana, and Illinois.

From this brief regional description it can be concluded that the Ohio River Basin encompasses areas of great resource diversity and of considerable differences in the characteristics which determine the location of economic activity. The Basin is an area of contrasts ranging from the isolated, depressed, resource-dependent valleys of Appalachia to the highly diversified manufacturing centers of the Central Lowlands. As demonstrated in the next chapter, the Basin approximates "in miniature" the contrasts and the variety of economic conditions which mark the country as a whole.

With the guidance and approval of the Corps of Engineers, the study area was divided into 19 subareas on the basis of criteria described in Appendix A. These subareas are named for the principal tributaries whose drainage basin they approximate and for the sections into which the mainstem of the Ohio River has been subdivided for study purposes. For a delineation of the subareas, see Appendix B, which lists their constituent counties, and the Ohio River Basin reference map provided by the U.S. Army Engineer Division, Ohio River.

B. ORGANIZATION OF THE REPORT

This report is organized with the user in mind. The next chapter presents the projection results, i.e., the employment and output figures for the benchmark and terminal years of the 50-year projection period, for the Ohio River Basin and its subareas. These data will presumably be used by the agencies working together to develop long-term plans for water and related land resources in the region, and by private research and planning groups.

---

*Bogue and Beale, op. cit., p. 218.

For those who will need to retrace the steps followed in making these projections, Chapter III describes the methodological framework for a two-pronged approach to projecting the future of the region -- the demographic approach which expresses the future supply of labor given certain assumptions about the birth rate, death rate, and rates of inward or outward migration; and the approach set forth in the econometric model which, by simulating the operation of the regional economy, gives quantitative estimates of future demand for labor in the Basin. A reconciliation of these two approaches produces what we call a condition of equilibrium between the forces of demand for labor and the supply of labor. Chapter IV, a sequel to Chapter III, traces the steps taken in implementing the methodological framework and in making the model operational as an instrument for projection.

Chapter V contains a number of special studies in which the results of the Ohio River Basin projections are used to obtain estimates of the future size of urban populations, the number of households, and levels of power generation in the 19 subareas. Population projections for selected metropolitan areas in the Basin are also presented in that chapter.

The Appendices, which are organized in the same sequence as the main body of the report, provide the detailed support data for the steps described in Chapters IV and V, as well as a complete set of projection tables.

C. PROJECTIONS AND THEIR ASSUMPTIONS

Economic projections attempt a view of the future based primarily on present knowledge of foreseeable developments and relationships of the past. Once the strategic assumptions are made, and the projective apparatus is spelled out, the projections follow logically from the assumptions. It should be clear, therefore, that a projection is not a prediction or a prophesy of the future, but rather a forecast of what might occur if a number of specific assumptions regarding the structure and behavior of the economy were, in fact, to materialize.

The assumptions made for this study take their cue from the stipulation by the Corps of Engineers that the economic projections should be based on "the timely availability of water in sufficient quantity and quality to support the projected economy . . ." and "a high level of national employment and activity, no major depressions or wars, and a continuation of the current relative needs of the civilian economy and the national defense."

This stipulation was carefully followed in the working assumptions which guided every step of our economic study. In particular, we selected a set of assumptions for the projection of gross national product which extend a long-term historic growth trend and are rather more conservative than those used in

recent national projections establishing growth goals for the economy (see Appendix C). The assumptions about the future course of the national economy are complemented by a host of explicit and implicit assumptions about expected rates of change in the economy of the Ohio River Basin; these are spelled out in Chapter IV.

Being an outgrowth of specific assumptions, projections should lend themselves to alterations. As conditions change and new data become available for the nation and for the region, it will be necessary to change the assumptions on which this study is based. Revised projections resulting from a new set of assumptions should then be obtained. In order to facilitate this task, we have been as explicit as possible in our description of the methodology and the implementation of our projective framework, giving full documentation to each of the steps in the Appendices.

CHAPTER II

PROJECTION RESULTS

A. NATIONAL PROJECTIONS

Projections of national growth measures were prepared to provide general guidelines for the demographic and economic projections of the Ohio River Basin. Individual components of the gross national product projection were used in the implementation of the regional econometric model described in Chapter IV.

Table II-1 presents, in summary form, the national projections of population, employment, gross national product, and industrial production developed for this study. A detailed treatment, setting forth our assumptions, sources, and projection methods, is provided in Appendix C.

Our population projection, which is based on the Census Bureau's Series III "moderate growth rate" projection, envisages more than a doubling of the U.S. population between 1960 and 2010. The total labor force of the nation is expected to grow at a slightly faster rate than the population. This will be so because we assume, in line with Bureau of Labor Statistics estimates of future participation rates, that an increasing share of the population age 14 and over (a smaller share of males but a considerably larger share of females) will be in the labor force. We have assumed, moreover, that the size of the armed forces would decline gradually to a level of about 2 million by the end of the projection period and that the unemployed would not exceed 4 percent of the civilian labor force, which is equivalent to a condition of essentially full employment. Accordingly, total U.S. employment is projected to rise by 137 percent during the 50-year period. (By comparison, the projection of Ohio River Basin employment shows a 50-year increase of only 88 percent.)

Our projection of gross national product to 2010 implies an average annual growth rate of 3.3 percent. It is anticipated that the increase in real product per man-hour will account for the larger part of the increase in GNP. The labor input will grow at a somewhat slower annual rate than the labor force due to an expected gradual decline in hours of work.

Estimates of average annual rates of growth are shown below:

	Labor Force	Labor Input	Real Product per Man-Hour	GNP
		(percent per annum)		
1980/1957	1.5	0.9	2.5	3.4
2010/1980	1.7	1.3	1.9	3.2
2010/1957	1.6	1.1	2.2	3.3

TABLE II-1

POPULATION, EMPLOYMENT, GROSS NATIONAL PRODUCT, AND INDUSTRIAL PRODUCTION, UNITED STATES,* 1980 AND 2010

	1957 Actual	1960 Actual	1980	2010
			Millions of Persons	
Population--total**	171.2	179.8	244.8	378.2
14 and over	122.0	126.7	175.4	280.4
Labor Force	70.7	72.8	100.1	166.1
Participation rate (as percent of population age 14 and over)	58.0%	57.3%	57.0%	59.2%
Armed Forces	2.8	2.5	2.2	2.0
Civilian Labor Force	67.9	70.3	97.9	164.1
Unemployment	2.9	3.9	3.9	6.6
Employed--total	65.0	66.4	94.0	157.6
General government	6.3	6.9	11.4	21.2
Farm	6.2	5.7	3.0	2.4
Private nonagricultural	52.5	53.8	79.6	134.0
			Billions of Dollars	
Gross National Product, 1954 prices	408.6	439.9	874.3	2271.2
Government	33.2	34.7	49.6	84.5
Farm	20.6	21.8	24.8	30.2
Private nonagricultural	354.8	383.4	799.9	2156.5
Industrial Production Index (1957 = 100)	100	108	227	631

*Excludes Alaska and Hawaii.

**Based on Census Bureau Series III population projection.

Source: Appendix C

B. OHIO RIVER BASIN PROJECTIONS

1. Population

In 1960, the Ohio River Basin contained 19 million people or approximately 11 percent of the population of the coterminous United States. This share has been gradually decreasing since the beginning of the century, when the Basin accounted for 14 percent of the national total; it is projected to decline even further, though at a slower rate, so that by the end of the projection period the Basin can be expected to account for only about 8 percent of the nation's population (Table II-2). The projected difference in rates of population growth between region and nation is based on our assumption of a continued outward movement of people from the Basin to other parts of the United States in response to inter-regional differentials in economic opportunity that will gradually diminish during the projection period.*

TABLE II-2

POPULATION AND LABOR FORCE, OHIO RIVER BASIN, 1980 AND 2010

	1960	1980	2010
Population (000's)	19,001	23,062	31,595
Population as Percent of U.S.	10.6	9.4	8.4
Labor Force (000's)	6,918	8,614	12,722
Labor Force as Percent of U.S.	9.5	8.6	7.7

Source: Tables I and III, Appendix H.

The decadal rates of population growth, shown below, illustrate the historical lag of the region behind the nation. This lag was accentuated during the period 1940-60, when out-migration from the Basin reached its peak; during the 1950's, when the national rate of natural increase reached new highs, the U.S. population grew at twice the rate of increase experienced by the Ohio River Basin. Our assumptions about a gradual decrease in net out-migration from the Basin (i.e., total outward movement minus total inward movement of population) accounts for the gradual narrowing of the gap between regional and national growth rates during the projection period.

*This assumption is detailed in Appendix D.

DECADAL RATES OF POPULATION GROWTH

	Ohio River Basin	Coterminous United States
	(in percent)	
Actual		
1900-1910	13.6	21.0
1910-1920	10.4	15.0
1920-1930	9.9	16.2
1930-1940	6.5	7.3
1940-1950	8.3	14.5
1950-1960	9.3	18.5
Projected		
1960-1970	8.3	15.6
1970-1980	12.1	17.7
1980-1990	11.9	17.0
1990-2000	10.8	15.4
2000-2010	10.4	14.4

Sources: Census of Population; Bureau of the Census Series III national projections; Ohio River Basin "equilibrium" projections (see Appendix H).

2. Labor Force

The labor force of the Ohio River Basin, which in 1960 accounted for about 36 percent of the total population, is projected to grow somewhat more rapidly than the population because we have assumed that regional participation rates will move closer to the national labor force participation rates projected by the Bureau of Labor Statistics. It is expected that as the Basin becomes more urbanized and as the birth rate declines, there will be an increase in labor force participation, particularly among women. In 2010, therefore, the Basin's labor force is projected to include just over 40 percent of the population, as compared with 43 percent in the nation. Even so, the Basin will account for only 7.7 percent of the nation's labor force, whereas in terms of total population the Basin will account for 8.4 percent of the country.*

*Labor force participation rates are discussed in Appendix C for the nation and in Appendix D for the Ohio River Basin.

3. Employment

As pointed out in Chapter I, the industry employment pattern of the Ohio River Basin bears a marked structural resemblance to that of the United States, particularly when the comparison is made at a level of industry aggregation (i.e., for major industry groups such as agriculture, manufacturing, trade, etc.) which masks some of the inevitable differences in detailed industry composition (Figures 1 and 2). In the Basin, as in the nation, manufacturing accounted for a growing share of total employment between 1930 and 1960, but in the Basin manufacturing continues to be more important as a source of employment (approximately 31 percent in 1960) than in the country as a whole (approximately 27 percent).

It is in the mining sector that the most important differences between national and regional employment shares are to be found. The Basin, which produces about three-quarters of the country's coal, had about 3 percent of its working population engaged in mining in 1960, while the national share was only one percent. It is noteworthy, however, that in mining, unlike in manufacturing, the employment share has undergone a drastic decline, especially since 1950; in the nation as a whole that share declined by almost 40 percent, while in the Ohio River Basin it declined by more than 55 percent during the 1950-60 decade.

A similar decrease in share was experienced by agricultural employment in the United States and in the Basin. In 1930, agriculture accounted for more than 20 percent of total employment, whereas in 1960 it accounted for less than 7 percent regionally as well as nationally.

The historical decrease in the contribution of agriculture and mining to total employment in the Ohio River Basin is redressed in part by the growing proportion of jobs in the trades, services and the government sector. This trend is evident at both national and regional levels, but in 1960 the Basin still trailed the United States in these categories of employment.

To the extent that historical trends are reflected in the assumptions about the future behavior of the economy, the Ohio River Basin projections developed in this study extend the structural changes in industry composition which have occurred over the past three decades. As may be deduced from Table II-3, the primary sectors (agriculture, forestry, fisheries and mining) will account for an ever decreasing share of total employment (from 9.2 percent in 1960 to 2.4 percent in 2010), and will also experience significant absolute reductions in the number of persons employed, as a result of anticipated further increases in productivity.

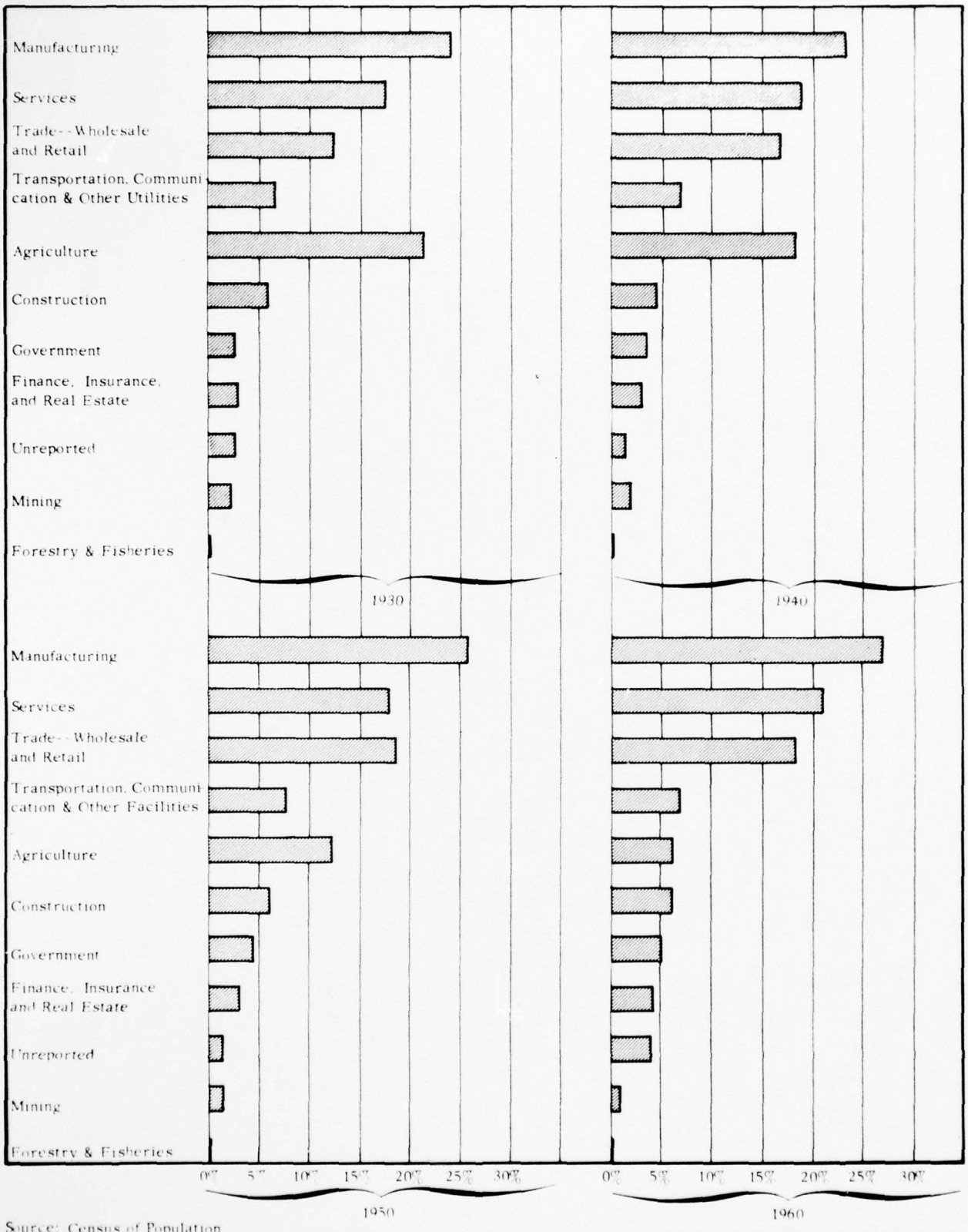
In the light of the likely job-displacing effects of automation, manufacturing is not expected to hold its own as a share of total employment in the

TABLE II-3

EMPLOYMENT AND LABOR FORCE, OHIO RIVER BASIN, 1980 AND 2010
(in thousands of persons)

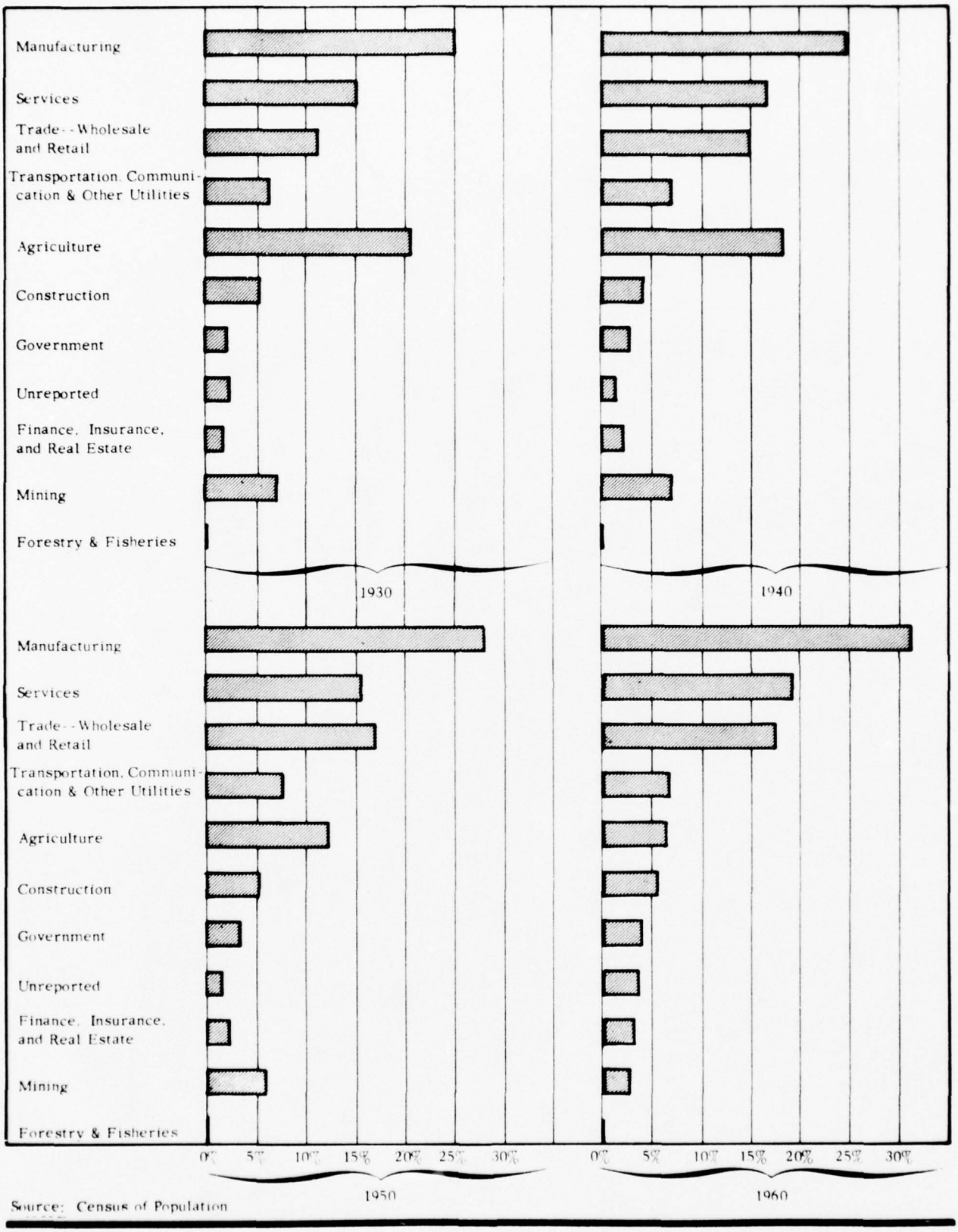
Industry Category	1960	1980	2010
Agriculture, Forestry and Fisheries	420.7	203.3	157.7
Mining:	171.7	141.5	128.2
Coal Mining	136.8	96.5	69.2
Other Mining	34.9	45.0	59.0
Construction	352.3	484.0	1,068.4
Manufacturing:	1,990.9	2,387.0	3,056.4
Lumber and wood products, furniture & fixtures	94.0	142.6	244.7
Primary metals	355.9	218.8	151.5
Fabricated metal products	148.0	217.8	380.4
Machinery, except electrical	197.8	308.9	442.3
Electrical machinery	234.4	382.1	593.8
Transportation equipment (except motor vehicles)	61.6	73.1	64.1
Motor Vehicles	89.1	103.1	88.4
Other durable goods	185.2	207.8	235.3
Food and kindred products	166.1	159.6	142.1
Textile mill products	19.6	21.5	22.3
Apparel and finished products	70.2	107.8	194.5
Printing, publishing and allied products	111.2	144.7	180.2
Chemicals and allied products	107.5	119.3	109.3
Other nondurable goods	150.3	179.9	207.5
Transportation, Communications and Utilities	436.0	525.5	647.2
Wholesale and Retail Trade	1,128.4	1,555.1	1,921.8
Finance, Insurance and Real Estate	205.1	321.1	426.1
Services	1,232.6	1,936.0	3,550.6
Government	256.3	395.8	824.4
Nonclassifiable	227.5	178.8	265.0
TOTAL EMPLOYMENT	6,421.5	8,128.1	12,045.8
Unemployment	411.4	409.8	607.4
CIVILIAN LABOR FORCE	6,832.9	8,537.9	12,653.2
Armed Forces	85.3	76.0	69.0
TOTAL LABOR FORCE	6,918.2	8,613.9	12,722.2

Source: For derivation, see Chapter IV and Table I, Appendix H.



Source: Census of Population

FIGURE 1 INDUSTRY EMPLOYMENT AS PERCENT OF TOTAI EMPLOYMENT, UNITED STATES



Source: Census of Population

FIGURE 2 INDUSTRY EMPLOYMENT AS PERCENT OF TOTAL EMPLOYMENT, OHIO RIVER BASIN

Ohio River Basin. According to Table II-3, more than one million jobs in manufacturing will be added between 1960 and 2010 in the Basin, but the 2010 figure represents but 25 percent of the total employment projected for that year (the same share that Basin manufacturing held in 1930). Within the manufacturing sector, the most significant absolute increases in employment are projected to occur in the following industries: wood products and furniture, apparel, fabricated metal products, and electrical and nonelectrical machinery.

Employment in the services is expected to grow three-fold -- a rate which substantially exceeds the projected rate of increase in total employment in the Ohio River Basin between 1960 and 2010. By the turn of the next century, more persons can be expected to work in the services than in all the manufacturing industries combined.

4. Output of Industry

The output projections shown in Table II-4 deserve careful consideration because they constitute the primary product of the model described in Chapters III and IV. These output projections were converted into employment projections by applying independently derived productivity factors. In view of the uncertainties surrounding future changes in productivity, we believe that the output rather than the employment projections are the more consistent and reliable guides to the future growth of the Basin's economy.

In Table II-4, the gross output of manufacturing industries, expressed in constant dollars, is shown to double between 1960 and 1980 and then to grow by another 143 percent between 1980 and 2010. Electrical machinery, transportation equipment, and chemicals top the list of the Basin's growth industries in terms of gross output.

The following tabulation gives growth indexes for the projected output of individual manufacturing industries in the Basin.

Industry	1980	2010
	(1960 = 100.00)	
Food and Kindred Products	185.7	453.8
Textile Mill Products	183.2	429.4
Apparel and Finished Products	192.5	482.3
Lumber and Wood Products, Furniture and Fixtures	188.9	463.4
Paper and Allied Products	210.0	527.3
Printing, Publishing, and Allied Products	208.8	528.9
Chemicals and Allied Products	229.2	620.0
Petroleum Refining	214.6	582.3
Rubber and Miscellaneous Plastics	209.3	545.2
Stone, Clay and Glass Products	179.8	434.1
Ferrous Metals	111.5	153.8
Nonferrous Metals	189.7	444.7
Fabricated Metal Products	193.4	494.5
Machinery, except Electrical	224.3	540.8
Electrical Machinery	244.2	662.2
Transportation Equipment	254.4	644.0
Motor Vehicles	241.1	642.8
Tobacco and Leather Products	185.1	438.7
Ordnance, Instruments and Miscellaneous Manufacturing	228.5	593.2

5. Personal Income

Projections of personal income were derived from the econometric model used to project gross output by industry sector in the Ohio River Basin (see Appendix H). The following tabulation gives total and per capita personal income for the base year and for each of the projection years in terms of 1960 dollars. It will be noted that per capita income in the Basin is projected to grow by 237 percent between 1960 and 2010.

Year	Total Personal Income (millions of 1960 dollars)	Per Capita Personal Income (1960 dollars)
1960	37,769	1,988
1970	55,234	2,685
1980	78,586	3,408
1990	108,639	4,209
2000	152,311	5,323
2010	211,533	6,695

TABLE II-4

OUTPUT BY INDUSTRY, OHIO RIVER BASIN, 1980 AND 2010
(in millions of 1960 dollars)

Industry Category	1960	1980	2010
Agriculture, Forestry and Fisheries	4,510.4	4,753.7	6,505.9
Mining:	2,457.8	4,911.9	11,677.3
Coal Mining	1,391.1	2,862.6	6,697.3
Other Mining	1,066.7	2,049.3	4,980.0
Construction	7,174.1	15,529.9	42,760.0
Manufacturing:	47,400.7	92,242.5	224,458.9
Lumber and wood products, furniture & fixtures	1,185.3	2,239.5	5,493.1
Primary metals	9,633.7	11,744.2	18,551.2
Fabricated metal products	3,370.9	6,518.3	16,669.8
Machinery, except electrical	4,029.9	9,038.7	21,792.4
Electrical machinery	4,504.0	10,998.4	29,825.4
Transportation equipment (except motor vehicles)	1,469.7	3,738.6	9,465.1
Motor vehicles	3,347.1	8,070.5	21,516.4
Other durable goods	3,020.0	5,794.9	14,301.1
Food and kindred products	6,390.9	11,865.5	29,003.0
Textile mill products	232.3	425.5	997.5
Apparel and finished products	696.9	1,341.8	3,361.2
Printing, publishing and allied products	1,308.5	2,731.9	6,920.8
Chemicals and allied products	3,920.8	8,985.2	24,308.6
Other nondurable goods	4,290.7	8,749.5	22,253.3

Source: For derivation, see Chapter IV and Table II, Appendix H.

C. SUBAREA PROJECTIONS

The subarea projections of employment and output by industry are the result of an allocation procedure used to distribute Ohio River Basin projection totals among the 19 subareas. The allocation procedure and the method used to derive subarea labor force and population projections from the employment totals are described in Appendix I.

Figures 3 and 4 present a comparison of subarea shares of Basin population and total employment for the years 1960, 1980 and 2010. The following noteworthy trends are revealed by these charts:

1. The population and, to a somewhat lesser extent, the employment shares are projected to increase in the northern and western subareas of the Ohio River Basin at the expense of the Appalachian subareas.

2. The subareas which were delineated along the mainstem of the Ohio River do not exhibit a uniform pattern of growth. The subareas containing the principal primary metal manufacturing centers are projected to have a declining share of the Basin's population and employment, while the subarea centered on Louisville is shown to increase its share by 2010.

3. No generalizations can be made about the influence of major metropolitan areas upon subarea growth trends. Clearly the Pittsburgh metropolitan area, which is coextensive with Subarea C, will suffer the greatest proportional decline in population and employment shares during the projection period. In Ohio and Indiana, on the other hand, it appears that the metropolitan concentrations around Columbus, Dayton, and Indianapolis will contribute to a significant increase in the shares of the subareas in which they are situated.

An analysis of projected subarea shares of Ohio River Basin employment in each industry group (see Tables in Appendix I) offers useful insights into the changes in industrial location that can be expected to occur during the projection period. The highlights of this share analysis are summarized below for selected industry groups:

Agriculture, Forestry and Fisheries	--	The dominant subareas (Wabash, Cumberland, Licking-Kentucky-Salt and White), which together in 1960 accounted for almost half of the Basin's employment in this industry group, are projected to maintain or to expand their share.
Mining	--	Two subareas (Guyandot-Big Sandy-Little Sandy and Kanawha-Little Kanawha) will increase their share at the expense of the coal-mining districts of western Pennsylvania and northern West Virginia.

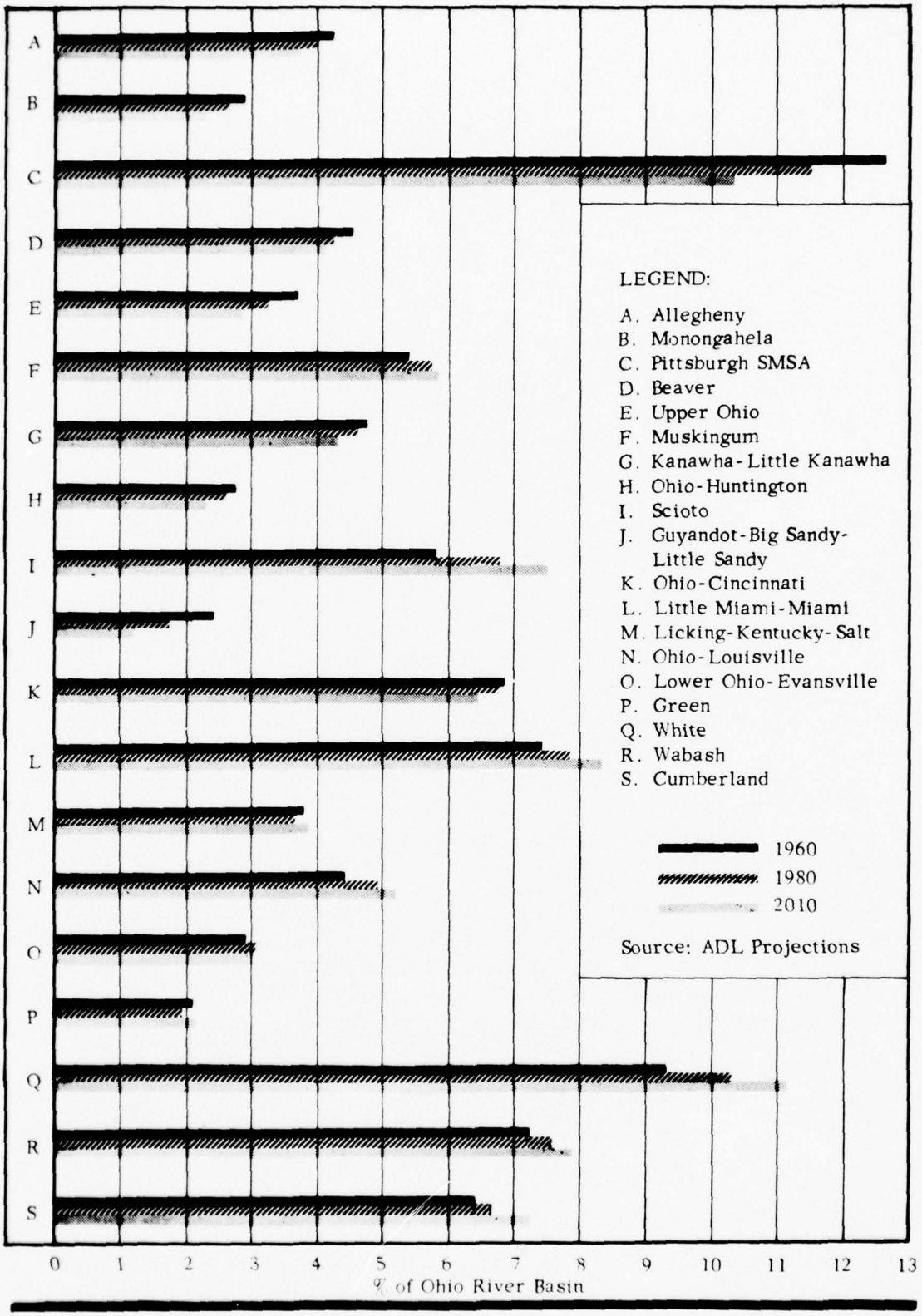


FIGURE 3 SUBAREA SHARES OF POPULATION IN OHIO RIVER BASIN

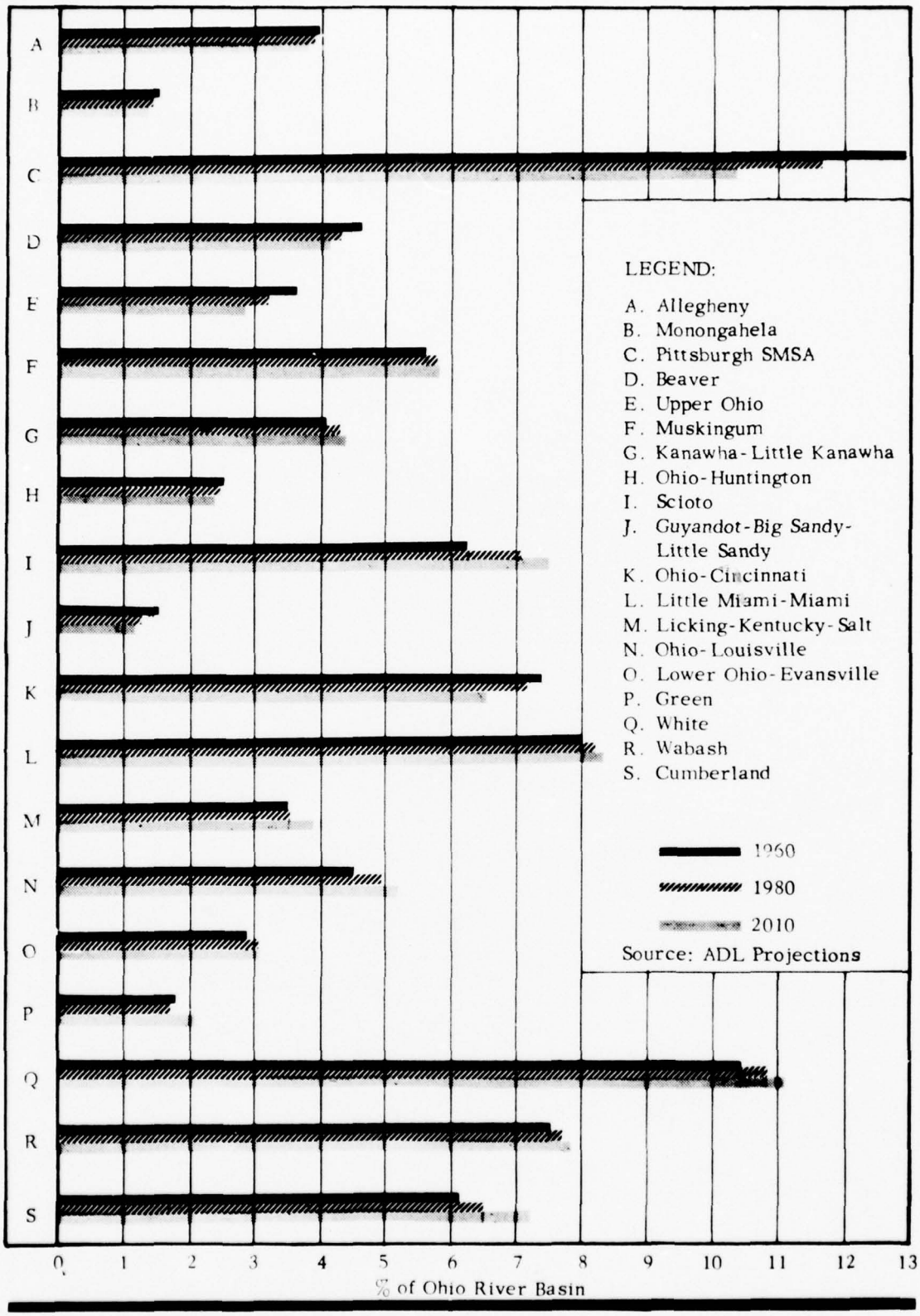


FIGURE 4 SUBAREA SHARES OF EMPLOYMENT IN OHIO RIVER BASIN

Lumber, Wood Products and Furniture	--	The drainage basins of the White and Cumberland rivers will continue to account for about one-quarter of total employment in this manufacturing category. Subarea D (Beaver) is indicated as a substantial growth area.
Fabricated Metals	--	Pittsburgh, Ohio-Cincinnati and Lower Ohio-Evansville are shown to be the principal gainers. These three subareas are projected to contain 45 percent of the Basin's employment in fabricated metals by 2010, as against less than 30 percent in 1960.
Machinery, Electrical and Nonelectrical	--	This industry is projected to move westward, with the principal gains in employment shares assigned to the White, Wabash, Muskingum, Scioto, and Ohio-Louisville subareas.
Transportation Equipment except Motor Vehicles	--	Major share increases are projected for the Scioto and White subareas, which are expected to account for over 60 percent of total Basin employment in this group. Significant decreases are projected for the Pittsburgh and Beaver subareas.
Motor Vehicles	--	No substantial changes are expected in the location of this industry in the Ohio River Basin. Some relative gains are projected for Ohio-Cincinnati, Scioto and Muskingum.
Textiles	--	Increasing concentration in the Kanawha Valley.
Apparel	--	Growing concentration of this industry can be expected in the Appalachian Plateau (Allegheny, Kanawha-Little Kanawha) and in the rural areas of northern Tennessee and western Kentucky (Cumberland and Green).
Chemical and Allied Products	--	The Kanawha Valley is projected to maintain most of its 1960 share (20 percent of employment in the Ohio River Basin), while Ohio-Louisville, White, and Wabash are expected to enlarge their shares considerably by 2010.

Table II-5 gives employment, labor force, and population projections, and Table II-6 provides projections of output by industry for each of the 19 subareas. For brief subarea profiles, see Appendix L.

TABLE II-5

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010 FOR OHIO RIVER BASIN SUBAREAS

(This table, which begins on the next page, consists of 19 panels, one for each subarea. The data were derived from Table I in Appendix H and Table I in Appendix I.)

TABLE II-5A

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010
SUBAREA: A - ALLEGHENY
(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	12.49	7.83	5.53	4.65	4.24	4.16
B.		Mining	15.60	12.34	10.20	8.65	7.87	7.39
	12	Coal Mining	12.42	9.73	7.86	6.45	5.41	4.74
	10, 13, 14	Other Mining	3.18	2.61	2.34	2.20	2.46	2.65
C.	15-17	Construction	12.20	14.41	15.94	21.27	27.65	31.21
D.		Manufacturing	89.56	99.97	113.01	125.20	144.53	164.47
	24-25	Lumber and Furniture	4.74	5.99	7.32	8.75	10.75	12.85
	33	Primary Metals	21.91	16.75	13.92	11.92	10.88	10.11
	34	Fabricated Metals	7.48	10.85	14.31	18.30	23.60	29.48
	35-36	Machinery and Electrical Machinery	16.31	23.77	31.79	38.08	46.18	53.67
	37 except 371	Transportation Equipment	1.34	1.39	1.39	1.20	1.02	.89
	371	Motor Vehicles	.42	.51	.58	.59	.59	.58
	19, 32, 38-39	Other Durables	14.46	15.54	16.73	17.37	18.70	19.72
	20	Food	4.64	4.56	4.25	3.92	3.71	3.47
	22	Textiles	.22	.22	.12	.03	.02	.01
	23	Apparel	5.35	8.58	11.70	15.29	19.55	24.45
	27	Printing	3.07	3.58	4.05	4.33	4.74	5.08
	28	Chemicals	2.55	1.84	1.06	.34	.28	.22
		Other Nondurables	7.07	6.39	5.79	5.08	4.51	3.94
	26	Paper	(n.a.)	(1.18)	(1.07)	(.94)	(.83)	(.73)
	29	Petroleum Refining	(n.a.)	(2.98)	(2.70)	(2.37)	(2.10)	(1.84)
	30	Rubber and Plastics	(n.a.)	(.99)	(.87)	(.74)	(.63)	(.53)
	21, 31	Tobacco and Leather	(n.a.)	(1.24)	(1.15)	(1.04)	(.94)	(.84)
E.	40-49	Transportation, Communications, and Utilities	17.50	19.47	21.18	22.25	24.57	26.41
F.	50-59	Wholesale and Retail Trade	43.20	50.44	58.16	59.92	65.61	69.95
G.	60-67	Finance, Insurance, and Real Estate	5.70	7.09	8.73	9.45	10.40	11.21
H.	70-89	Services	46.30	59.84	72.79	87.39	103.04	129.60
I.		Government	6.50	5.92	6.25	6.61	7.07	6.92
		Nonclassified	7.20	3.33	4.13	4.84	5.40	6.14
TOTAL EMPLOYMENT			256.70	280.64	315.92	350.23	400.38	457.46
Unemployment			25.44	20.40	21.22	21.56	22.43	23.06
Civilian Labor Force			282.14	301.04	337.14	371.79	422.81	480.52
Armed Forces			.18	.17	.16	.15	.15	.14
TOTAL LABOR FORCE			282.32	301.21	337.30	371.94	422.96	480.66
TOTAL POPULATION			805.10	845.55	922.48	1011.91	1101.64	1193.70

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TABLE II-5B

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010

SUBAREA: B - MONONGAHELA

(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	8.12	5.17	3.44	2.73	2.37	2.22
B.		Mining	22.50	16.22	12.91	10.44	8.71	7.53
	12	Coal Mining	21.40	15.17	11.83	9.32	7.46	6.18
	10, 13, 14	Other Mining	1.10	1.05	1.08	1.12	1.25	1.35
C.	15-17	Construction	8.70	10.72	12.59	17.45	23.60	28.42
D.		Manufacturing	33.23	37.16	41.06	44.17	49.29	54.53
	24-25	Lumber and Furniture	3.29	3.86	4.52	5.21	6.19	7.19
	33	Primary Metals	4.83	4.54	4.31	3.97	3.70	3.47
	34	Fabricated Metals	2.14	2.37	2.64	2.91	3.37	3.84
	35-36	Machinery and Electrical Machinery	3.72	5.15	7.26	8.93	11.15	13.26
	37 except 371	Transportation Equipment	.18	.31	.37	.37	.37	.37
	371	Motor Vehicles	.26	.67	.78	.81	.83	.83
	19, 32, 38-39	Other Durables	10.29	9.99	9.64	9.07	8.91	8.62
	20	Food	2.66	1.97	1.77	1.60	1.46	1.34
	22	Textiles	.27	.27	.27	.27	.28	.27
	23	Apparel	2.51	3.91	5.40	7.12	9.16	11.53
	27	Printing	1.63	1.77	1.95	2.04	2.18	2.31
	28	Chemicals	.68	1.08	.87	.64	.46	.28
		Other Nondurables	.77	1.27	1.28	1.23	1.23	1.22
	26	Paper	(n.a.)	(.47)	(.48)	(.46)	(.46)	(.46)
	29	Petroleum Refining	(n.a.)	(.28)	(.28)	(.27)	(.27)	(.27)
	30	Rubber and Plastics	(n.a.)	(--)	(--)	(--)	(--)	(--)
	21, 31	Tobacco and Leather	(n.a.)	(.51)	(.52)	(.50)	(.50)	(.50)
E.	40-49	Transportation, Communications, and Utilities	14.70	16.68	18.18	19.24	21.25	22.91
F.	50-59	Wholesale and Retail Trade	29.70	35.94	41.68	43.08	47.37	50.74
G.	60-67	Finance, Insurance, and Real Estate	3.60	4.42	5.39	5.80	6.34	6.82
H.	70-89	Services	32.60	42.56	51.30	61.48	71.96	89.83
I.		Government	5.20	5.73	6.81	8.30	10.14	11.87
		Nonclassified	4.00	2.73	3.02	3.53	4.19	4.98
		TOTAL EMPLOYMENT	162.20	177.33	196.38	216.22	245.22	279.83
		Unemployment	18.00	14.22	14.29	14.12	14.20	14.10
		Civilian Labor Force	180.20	191.55	210.67	230.34	259.42	293.93
		Armed Forces	.13	.13	.12	.12	.11	.11
		TOTAL LABOR FORCE	180.33	191.68	210.79	230.46	259.53	294.04
		TOTAL POPULATION	556.10	573.99	606.53	647.93	686.74	730.23

TABLE II-5C

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010
SUBAREA: C - PITTSBURG SMSA
(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	7.54	4.71	3.35	2.85	2.61	2.57
B.		Mining	11.50	8.90	7.39	6.26	5.61	5.19
	12	Coal Mining	9.81	7.40	5.92	4.79	3.97	3.42
	10, 13, 14	Other Mining	1.69	1.50	1.47	1.47	1.64	1.77
C.	15-17	Construction	42.10	46.55	51.13	69.79	90.18	102.69
D.		Manufacturing	308.20	283.87	271.56	258.77	259.47	261.19
	24-25	Lumber and Furniture	3.20	2.79	2.79	2.74	2.73	2.64
	33	Primary Metals	134.90	100.68	79.05	64.57	56.50	50.62
	34	Fabricated Metals	27.62	34.25	41.23	49.35	60.61	72.77
	35-36	Machinery and Electrical Machinery	51.92	53.83	57.56	55.78	54.94	51.70
	37 except 371	Transportation Equipment	6.12	6.96	5.01	2.62	.76	.29
	371	Motor Vehicles	3.22	3.78	4.17	4.12	4.06	3.94
	19, 32, 38-39	Other Durables	26.24	27.26	27.43	26.85	27.41	27.58
	20	Food	22.27	20.14	18.59	17.02	15.96	14.84
	22	Textiles	.51	.59	.52	.44	.39	.34
	23	Apparel	2.26	2.83	3.34	3.89	4.55	5.23
	27	Printing	12.70	14.19	15.71	16.48	17.71	18.76
	28	Chemicals	9.36	10.42	10.94	10.71	10.51	10.01
		Other Nondurables	7.96	6.15	5.22	4.20	3.34	2.47
	26	Paper	(n.a.)	(3.78)	(3.22)	(2.60)	(2.07)	(1.54)
	29	Petroleum Refining	(n.a.)	(.52)	(.39)	(.27)	(.18)	(.11)
	30	Rubber and Plastics	(n.a.)	(1.85)	(1.61)	(1.33)	(1.08)	(.82)
	21, 31	Tobacco and Leather	(n.a.)	(--)	(--)	(--)	(--)	(--)
E.	40-49	Transportation, Communications, and Utilities	64.00	76.21	83.61	88.63	98.40	106.21
F.	50-59	Wholesale and Retail Trade	149.00	173.96	197.50	200.64	216.49	228.12
G.	60-67	Finance, Insurance, and Real Estate	32.40	41.72	51.05	54.87	60.15	64.55
H.	70-89	Services	159.60	196.31	237.16	284.09	332.92	416.49
I.		Government	30.10	26.62	28.38	30.64	33.01	33.31
		Nonclassified	27.40	18.02	19.28	20.52	22.60	25.21
TOTAL EMPLOYMENT			832.10	876.87	950.41	1017.06	1121.44	1245.53
Unemployment			63.53	51.14	53.57	55.28	58.74	62.77
Civilian Labor Force			895.63	928.01	1003.98	1072.34	1180.18	1308.30
Armed Forces			1.73	1.64	1.54	1.47	1.43	1.39
TOTAL LABOR FORCE			897.36	929.65	1005.52	1073.81	1181.61	1309.69
TOTAL POPULATION			2405.40	2485.22	2654.44	2847.28	3088.81	3252.55

TABLE II-5D

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010
SUBAREA: D - BEAVER
(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	6.09	3.46	2.38	1.94	1.72	1.64
B.		Mining	2.10	1.73	1.59	1.49	1.44	1.42
	12	Coal Mining	1.49	1.43	1.25	1.12	1.03	.98
	10, 13, 14	Other Mining	.61	.30	.34	.37	.41	.44
C.	15-17	Construction	15.00	15.83	18.43	25.75	34.56	40.82
D.		Manufacturing	130.00	122.90	127.06	124.99	133.52	142.06
	24-25	Lumber and Furniture	3.63	6.22	8.37	10.80	14.04	17.67
	33	Primary Metals	63.59	45.87	36.91	30.75	27.42	25.04
	34	Fabricated Metals	11.97	12.92	13.94	15.24	17.30	19.36
	35-36	Machinery and Electrical Machinery	22.68	28.64	34.96	38.79	44.06	48.28
	37 except 371	Transportation Equipment	3.82	2.56	1.47	.32	.12	.06
	371	Motor Vehicles	2.17	2.87	3.34	3.44	3.51	3.48
	19, 32, 38-39	Other Durables	7.41	8.52	8.73	8.67	8.98	9.15
	20	Food	4.32	4.10	3.99	3.83	3.76	3.64
	22	Textiles	.35	.42	.49	.52	.57	.61
	23	Apparel	.83	.49	.19	.09	.06	.04
	27	Printing	3.34	4.09	4.91	5.49	6.23	6.92
	28	Chemicals	1.44	1.59	1.69	1.68	1.67	1.61
		Other Nondurables	4.43	4.61	5.07	5.37	5.80	6.20
	26	Paper	(n.a.)	(.83)	(.96)	(1.05)	(1.16)	(1.27)
	29	Petroleum Refining	(n.a.)	(.23)	(.20)	(.19)	(.17)	(.16)
	30	Rubber and Plastics	(n.a.)	(3.09)	(3.45)	(3.68)	(4.00)	(4.31)
	21, 31	Tobacco and Leather	(n.a.)	(.46)	(.46)	(.46)	(.46)	(.47)
E.	40-49	Transportation, Communications, and Utilities	19.20	20.67	22.54	23.73	26.26	28.22
F.	50-59	Wholesale and Retail Trade	50.10	58.96	69.36	72.71	80.63	87.06
G.	60-67	Finance, Insurance, and Real Estate	7.80	9.40	11.75	12.86	14.31	15.60
H.	70-89	Services	51.50	63.61	79.18	97.29	116.48	148.42
I.		Government	7.90	8.55	10.53	13.22	16.74	20.20
		Nonclassified	7.50	6.53	4.22	7.88	8.95	10.17
TOTAL EMPLOYMENT			298.20	311.64	347.04	381.86	434.61	495.61
Unemployment			20.09	16.40	18.08	19.68	22.16	24.98
Civilian Labor Force			318.29	328.04	365.12	401.54	456.77	520.59
Armed Forces			.32	.31	.29	.28	.27	.26
TOTAL LABOR FORCE			318.61	328.35	365.41	401.82	457.04	520.85
TOTAL POPULATION			864.10	886.70	970.91	1071.28	1178.90	1293.50

TABLE II-5E

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010

SUBAREA: E - UPPER OHIO

(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	8.94	6.41	4.41	3.60	3.19	3.08
B.		Mining	7.60	7.90	8.14	8.27	8.63	9.06
	12	Coal Mining	5.49	5.48	5.45	5.40	5.41	5.60
	10, 13, 14	Other Mining	2.11	2.42	2.69	2.87	3.22	3.46
C.	15-17	Construction	12.60	14.06	16.36	22.61	30.11	36.06
D.		Manufacturing	84.73	75.67	72.42	69.46	70.28	71.07
	24-25	Lumber and Furniture	2.01	2.69	3.19	3.72	4.46	5.26
	33	Primary Metals	35.04	26.78	22.49	19.36	17.62	16.24
	34	Fabricated Metals	6.92	7.66	8.49	9.50	11.03	12.59
	35-36	Machinery and Electrical Machinery	6.87	8.43	10.92	12.72	15.12	17.20
	37 except 371	Transportation Equipment	.12	.09	.08	.06	.05	.03
	371	Motor Vehicles	.24	.22	.22	.19	.17	.15
	19, 32, 38-39	Other Durables	14.02	12.12	9.79	7.39	5.46	3.51
	20	Food	4.11	3.25	2.92	2.60	2.38	2.15
	22	Textiles	.09	.26	.02	.01	.004	.002
	23	Apparel	1.18	1.30	1.58	1.93	2.34	2.78
	27	Printing	3.37	3.96	4.50	4.81	5.28	5.68
	28	Chemicals	7.37	6.21	5.76	5.01	4.41	3.76
		Other Nondurables	3.39	2.70	2.46	2.16	1.96	1.72
	26	Paper	(n.a.)	(.81)	(.58)	(.44)	(.34)	(.25)
	29	Petroleum Refining	(n.a.)	(.22)	(.20)	(.18)	(.17)	(.15)
	30	Rubber and Plastics	(n.a.)	(.46)	(.44)	(.40)	(.37)	(.33)
	21, 31	Tobacco and Leather	(n.a.)	(1.22)	(1.23)	(1.13)	(1.08)	(.99)
E.	40-49	Transportation, Communications, and Utilities	15.80	17.55	19.02	19.95	21.97	23.62
F.	50-59	Wholesale and Retail Trade	41.80	49.25	56.76	58.46	63.82	68.03
G.	60-67	Finance, Insurance, and Real Estate	5.60	6.83	8.25	8.71	9.43	10.01
H.	70-89	Services	41.40	51.36	61.95	73.73	86.24	107.58
I.		Government	6.90	8.12	10.09	12.81	16.41	19.87
		Nonclassified	6.20	2.98	2.34	2.05	3.10	4.52
TOTAL EMPLOYMENT			231.60	240.13	259.74	279.65	313.18	352.90
Unemployment			16.97	13.53	14.26	14.93	16.26	17.79
Civilian Labor Force			248.57	253.66	274.00	294.58	329.44	370.69
Armed Forces			.11	.11	.10	.09	.09	.09
TOTAL LABOR FORCE			248.68	253.77	274.10	294.67	329.53	370.78
TOTAL POPULATION			700.70	705.65	744.90	797.65	855.56	920.81

TABLE II-5F

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010
SUBAREA: F - MUSKINGUM
(In thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	22.84	15.38	11.20	9.65	8.98	9.00
B.		Mining	5.70	7.67	7.35	7.11	7.20	7.38
	12	Coal Mining	4.03	5.14	4.66	4.30	4.05	3.99
	10, 13, 14	Other Mining	1.67	2.53	2.69	2.81	3.15	3.39
C.	15-17	Construction	18.60	20.97	24.77	34.41	46.31	59.37
D.		Manufacturing	141.62	163.00	183.90	199.68	224.24	247.44
	24-25	Lumber and Furniture	3.24	3.91	4.83	5.85	7.23	8.74
	33	Primary Metals	25.11	21.30	17.27	14.43	12.93	11.82
	34	Fabricated Metals	13.87	18.66	22.24	26.45	32.28	38.57
	35-36	Machinery and Electrical Machinery	36.90	52.84	69.51	82.17	98.63	113.66
	37 except 371	Transportation Equipment	1.80	1.99	2.00	1.73	1.50	1.31
	371	Motor Vehicles	6.39	7.22	8.51	8.83	9.03	9.03
	19, 32, 38-39	Other Durables	23.35	22.58	22.15	21.16	21.12	20.78
	20	Food	8.38	8.77	9.02	9.03	9.16	9.11
	22	Textiles	.26	.34	.35	.35	.36	.36
	23	Apparel	1.21	1.47	1.78	2.12	2.51	2.96
	27	Printing	5.71	6.20	6.67	6.83	7.16	7.42
	28	Chemicals	2.04	2.16	2.23	2.16	2.10	1.98
		Other Nondurables	13.36	15.56	17.34	18.57	20.23	21.70
	26	Paper	(n.a.)	(3.89)	(3.47)	(3.06)	(2.93)	(2.93)
	29	Petroleum Refining	(n.a.)	(1.40)	(1.91)	(2.32)	(2.73)	(3.09)
	30	Rubber and Plastics	(n.a.)	(10.27)	(11.96)	(13.18)	(14.57)	(15.68)
	21, 31	Tobacco and Leather	(n.a.)	(--)	(--)	(--)	(--)	(--)
E.	40-49	Transportation, Communications, and Utilities	21.30	23.46	25.54	26.91	29.64	31.78
F.	50-59	Wholesale and Retail Trade	61.40	72.67	85.37	89.39	99.04	106.85
G.	60-67	Finance, Insurance, and Real Estate	9.80	12.05	15.19	16.76	18.77	20.58
H.	70-89	Services	61.30	76.95	94.86	115.66	137.48	174.33
I.		Government	10.30	12.27	15.52	19.93	25.81	31.74
		Nonclassified	11.00	11.12	13.11	14.84	17.11	19.63
TOTAL EMPLOYMENT			363.90	415.54	476.81	534.34	614.58	708.10
Unemployment			22.09	20.13	23.34	26.41	30.68	35.69
Civilian Labor Force			385.99	435.67	500.15	560.75	645.26	743.79
Armed Forces			.22	.21	.20	.19	.18	.18
TOTAL LABOR FORCE			386.21	435.88	500.35	560.94	645.44	743.97
TOTAL POPULATION			1040.30	1168.55	1326.07	1489.47	1662.47	1847.61

TABLE II-5G

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010

SUBAREA: G - KANAWHA-LITTLE KANAWHA

(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	18.71	13.19	8.84	7.11	6.20	5.87
B.		Mining	23.80	18.25	14.66	11.92	10.20	8.90
	12	Coal Mining	20.99	15.13	11.20	8.23	6.06	4.45
	10, 13, 14	Other Mining	2.81	3.12	3.46	3.69	4.14	4.45
C.	15-17	Construction	14.70	20.89	25.48	35.48	48.38	59.20
D.		Manufacturing	62.56	70.55	79.23	85.88	95.67	105.33
	24-25	Lumber and Furniture	9.18	11.13	13.12	15.26	18.23	21.41
	33	Primary Metals	2.83	2.47	2.25	2.04	1.92	1.79
	34	Fabricated Metals	1.24	.78	.94	1.09	1.30	1.56
	35-36	Machinery and Electrical Machinery	3.28	4.33	5.94	7.27	9.03	10.67
	37 except 371	Transportation Equipment	.14	.16	.18	.18	.18	.17
	371	Motor Vehicles	.19	.21	.23	.23	.23	.23
	19, 32, 38-39	Other Durables	5.26	4.94	5.01	4.95	5.10	5.18
	20	Food	3.65	3.25	3.16	3.04	2.97	2.87
	22	Textiles	6.20	7.31	8.00	8.23	8.81	9.15
	23	Apparel	5.04	7.95	11.25	15.09	19.66	24.95
	27	Printing	2.53	3.13	3.65	3.99	4.45	4.88
	28	Chemicals	21.09	22.84	23.34	22.31	21.47	20.08
		Other Nondurables	1.93	2.05	2.16	2.20	2.32	2.39
	26	Paper	(n.a.)	(--)	(--)	(--)	(--)	(--)
	29	Petroleum Refining	(n.a.)	(.53)	(.56)	(.57)	(.60)	(.62)
	30	Rubber and Plastics	(n.a.)	(.39)	(.41)	(.42)	(.44)	(.45)
	21, 31	Tobacco and Leather	(n.a.)	(1.13)	(1.19)	(1.21)	(1.28)	(1.31)
E.	40-49	Transportation, Communications, and Utilities	19.80	22.74	24.80	26.14	28.86	31.00
F.	50-59	Wholesale and Retail Trade	45.10	57.37	69.05	73.84	83.31	91.29
G.	60-67	Finance, Insurance, and Real Estate	4.90	7.17	9.22	10.29	11.69	12.95
H.	70-89	Services	51.80	70.20	87.70	107.65	128.80	164.39
I.		Government	9.60	12.92	16.90	22.34	29.54	37.02
		Nonclassified	8.80	5.39	5.95	6.67	7.55	8.84
TOTAL EMPLOYMENT			260.40	298.67	341.83	387.32	450.20	524.79
Unemployment			23.41	19.96	21.45	22.72	24.56	26.45
Civilian Labor Force			283.81	318.63	363.28	410.04	474.76	551.24
Armed Forces			.50	.47	.44	.42	.41	.40
TOTAL LABOR FORCE			284.31	319.10	363.72	410.46	475.17	551.64
TOTAL POPULATION			899.40	975.16	1063.16	1166.79	1264.74	1369.97

TABLE II-5H

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010

SUBAREA: H - OHIO-HUNTINGTON

(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	11.04	7.35	5.04	4.13	3.67	3.53
B.		Mining	2.22	3.62	4.11	4.44	4.85	5.21
	12	Coal Mining	.80	1.11	1.14	1.15	1.17	1.25
	10, 13, 14	Other Mining	1.42	2.51	2.97	3.29	3.68	3.96
C.	15-17	Construction	10.50	11.66	14.08	20.34	28.83	36.95
D.		Manufacturing	45.89	44.46	47.40	49.09	52.37	55.32
	24-25	Lumber and Furniture	2.67	3.84	4.89	6.05	7.62	9.35
	33	Primary Metals	15.55	9.33	7.85	6.81	6.23	5.83
	34	Fabricated Metals	.85	.44	.48	.57	.70	.84
	35-36	Machinery and Electrical Machinery	1.74	2.57	3.32	3.87	4.61	5.28
	37 except 371	Transportation Equipment	1.27	1.57	1.64	1.47	1.31	1.18
	371	Motor Vehicles	.93	1.53	1.85	1.95	2.01	2.03
	19, 32, 38-39	Other Durables	5.34	5.23	5.30	5.20	5.35	5.41
	20	Food	2.91	2.58	2.54	2.45	2.40	2.33
	22	Textiles	.17	.21	.24	.25	.27	.29
	23	Apparel	1.66	2.11	2.33	2.56	2.83	3.09
	27	Printing	1.61	1.66	1.85	1.94	2.10	2.23
	28	Chemicals	5.15	6.16	7.30	7.83	8.27	8.35
		Other Nondurables	6.04	7.23	7.81	8.14	8.67	9.11
	26	Paper	(n.a.)	(--)	(--)	(--)	(--)	(--)
	29	Petroleum Refining	(n.a.)	(2.17)	(2.11)	(2.04)	(2.09)	(2.14)
	30	Rubber and Plastics	(n.a.)	(1.01)	(1.09)	(1.14)	(1.21)	(1.28)
	21, 31	Tobacco and Leather	(n.a.)	(4.05)	(4.61)	(4.97)	(5.38)	(5.69)
E.	40-49	Transportation, Communications, and Utilities	17.20	20.43	25.85	23.18	25.48	27.25
F.	50-59	Wholesale and Retail Trade	28.70	34.34	40.12	41.78	46.30	49.77
G.	60-67	Finance, Insurance, and Real Estate	4.00	4.73	5.81	6.25	6.84	7.37
H.	70-89	Services	29.20	36.59	44.92	54.18	63.84	80.60
I.		Government	5.10	6.38	8.00	10.25	13.14	16.08
		Nonclassified	5.40	--	--	--	--	--
TOTAL EMPLOYMENT			157.20	169.56	195.33	213.64	245.32	282.08
Unemployment			14.88	11.84	12.70	12.85	13.57	14.22
Civilian Labor Force			172.08	181.40	208.03	226.49	258.89	296.30
Armed Forces			.17	.16	.15	.15	.14	.14
TOTAL LABOR FORCE			172.25	181.56	208.18	226.64	259.03	296.44
TOTAL POPULATION			531.70	543.13	599.61	637.61	686.74	736.19

TABLE II-51

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010

SUBAREA: I - SCIOTO

(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	21.59	14.13	10.35	8.98	8.37	8.42
B.		Mining						
	12	Coal Mining	1.40	1.23	1.35	1.43	1.60	1.73
	10, 13, 14	Other Mining	.05	.05	.05	.05	.05	.06
			1.35	1.18	1.30	1.38	1.55	1.67
C.	15-17	Construction	24.40	25.46	28.20	37.34	48.38	53.00
D.		Manufacturing	112.60	136.32	161.63	178.77	202.10	222.75
	24-25	Lumber and Furniture	2.51	2.73	3.15	3.57	4.19	4.85
	33	Primary Metals	4.40	3.01	2.45	2.04	1.82	1.67
	34	Fabricated Metals	10.44	12.03	13.70	15.68	18.92	21.68
	35-36	Machinery and Electrical Machinery	31.12	41.56	56.66	68.82	84.34	98.74
	37 except 371	Transportation Equipment	8.55	12.57	16.10	16.93	17.25	17.51
	371	Motor Vehicles	4.05	6.07	6.77	6.77	6.73	6.59
	19, 32, 38-39	Other Durables	14.04	16.86	18.79	20.03	22.06	23.72
	20	Food	10.63	12.16	11.95	11.54	11.36	11.03
	22	Textiles	1.21	1.30	1.36	1.34	1.40	1.42
	23	Apparel	1.36	1.06	.93	.77	.54	.27
	27	Printing	7.66	8.88	10.20	11.04	12.20	13.23
	28	Chemicals	3.99	4.19	4.62	4.70	4.77	4.67
		Other Nondurables	12.67	13.90	14.95	15.54	16.52	17.37
	26	Paper	(n.a.)	(7.92)	(8.82)	(9.32)	(9.99)	(10.55)
	29	Petroleum Refining	(n.a.)	(.21)	(.22)	(.23)	(.25)	(.26)
	30	Rubber and Plastics	(n.a.)	(2.78)	(3.44)	(3.73)	(4.05)	(4.30)
	21, 31	Tobacco and Leather	(n.a.)	(2.99)	(2.47)	(2.25)	(2.23)	(2.26)
E.	40-49	Transportation, Communications, and Utilities	26.70	28.46	30.43	31.52	34.35	36.50
F.	50-59	Wholesale and Retail Trade	73.50	84.78	99.22	103.64	114.59	123.38
G.	60-67	Finance, Insurance, and Real Estate	17.20	22.32	28.48	31.65	35.75	39.41
H.	70-89	Services	88.40	127.37	161.46	201.17	243.88	314.23
I.		Government	23.50	29.22	37.88	49.70	65.36	81.62
		Nonclassified	14.20	11.95	14.44	16.74	19.53	22.63
TOTAL EMPLOYMENT			403.00	481.24	572.09	660.94	773.91	903.67
Unemployment			20.30	20.16	25.18	30.52	37.38	45.54
Civilian Labor Force			423.30	501.40	597.27	691.46	811.29	949.21
Armed Forces			7.12	6.76	6.35	6.10	5.93	5.76
TOTAL LABOR FORCE			430.42	508.16	603.62	697.56	817.22	954.97
TOTAL POPULATION			1113.40	1320.79	1561.30	1825.05	2085.96	2371.62

TABLE II-5J

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010
SUBAREA: J - GUYANDOT, BIG SANDY, LITTLE SANDY
(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	3.75	2.64	1.24	.57	.14	.05
B.		Mining	36.20	26.62	20.52	15.95	12.66	10.25
	12	Coal Mining	34.50	24.53	18.09	13.28	9.67	7.03
	10, 13, 14	Other Mining	1.70	2.09	2.43	2.67	2.99	3.22
C.	15-17	Construction	4.20	5.29	6.30	8.94	12.30	14.81
D.		Manufacturing	7.00	7.16	7.70	8.04	8.53	9.12
	24-25	Lumber and Furniture	2.25	1.96	1.61	1.13	.60	.12
	33	Primary Metals	.27	.33	.31	.31	.31	.32
	34	Fabricated Metals	.09	.15	.20	.26	.32	.38
	35-36	Machinery and Electrical Machinery	.53	.71	.97	1.19	1.38	1.66
	37 except 371	Transportation Equipment	.03	.01	.01	.01	.01	.01
	371	Motor Vehicles	.15	.21	.26	.27	.30	.29
	19, 32, 38-39	Other Durables	1.14	.87	.83	.79	.77	.73
	20	Food	.89	.61	.54	.47	.43	.38
	22	Textiles	.01	--	--	--	--	--
	23	Apparel	.57	.86	1.24	1.69	2.24	2.86
	27	Printing	.56	.71	.85	.97	1.13	1.26
	28	Chemicals	.27	.34	.39	.39	.41	.40
		Other Nondurables	.31	.40	.49	.56	.63	.71
	26	Paper	(n.a.)	(--)	(--)	(--)	(--)	(--)
	29	Petroleum Refining	(n.a.)	(.40)	(.49)	(.56)	(.63)	(.71)
	30	Rubber and Plastics	(n.a.)	(--)	(--)	(--)	(--)	(--)
	21, 31	Tobacco and Leather	(n.a.)	(--)	(--)	(--)	(--)	(--)
E.	40-49	Transportation, Communications, and Utilities	6.80	7.45	7.94	8.17	8.81	9.25
F.	50-59	Wholesale and Retail Trade	15.30	20.23	24.26	25.75	29.14	31.71
G.	60-67	Finance, Insurance, and Real Estate	1.20	1.62	2.12	2.39	2.74	3.07
H.	70-89	Services	16.80	22.46	27.68	33.69	40.04	50.77
I.		Government	2.80	3.28	4.24	5.48	7.14	8.82
		Nonclassified	2.40	2.18	2.30	2.43	2.73	3.11
		TOTAL EMPLOYMENT	96.60	98.93	104.30	111.41	124.23	140.96
		Unemployment	12.33	8.98	8.41	7.87	7.51	7.10
		Civilian Labor Force	108.93	107.91	112.71	119.28	131.74	148.06
		Armed Forces	.10	.10	.09	.09	.09	.08
		TOTAL LABOR FORCE	109.03	108.01	112.80	119.37	131.83	148.14
		TOTAL POPULATION	463.70	423.80	401.28	389.79	377.70	367.90

TABLE II-5K

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010
SUBAREA: K - OHIO-CINCINNATI
(In thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	15.53	10.59	7.66	6.59	6.10	6.10
B.		Mining	.40	.41	.45	.47	.53	.57
	12	Coal Mining	--	--	--	--	--	--
	10, 13, 14	Other Mining	.40	.41	.45	.47	.53	.57
C.	15-17	Construction	27.30	28.54	31.14	42.53	54.60	62.12
D.		Manufacturing	156.90	160.00	169.93	169.45	174.91	178.79
	24-25	Lumber and Furniture	6.20	7.24	8.44	9.72	11.53	13.43
	33	Primary Metals	4.47	2.07	.92	.31	.17	.14
	34	Fabricated Metals	12.76	16.65	20.73	25.44	31.86	38.88
	35-36	Machinery and Electrical Machinery	28.87	27.76	27.16	23.39	19.54	14.40
	37 except 371	Transportation Equipment	12.60	4.47	5.33	5.31	5.22	5.14
	371	Motor Vehicles	11.76	14.43	16.14	16.17	16.07	15.74
	19, 32, 38-39	Other Durables	11.81	17.41	20.99	23.70	27.25	30.31
	20	Food	18.70	22.24	22.01	21.39	21.15	20.62
	22	Textiles	1.24	1.37	1.39	1.35	1.38	1.38
	23	Apparel	5.29	5.24	3.67	1.67	.91	.54
	27	Printing	13.38	14.01	14.44	14.14	14.25	14.22
	28	Chemicals	15.68	15.08	14.79	13.63	12.68	11.50
		Other Nondurables	13.97	14.27	13.92	13.23	12.90	12.49
	26	Paper	(n.a.)	(6.28)	(5.99)	(5.62)	(5.45)	(5.25)
	29	Petroleum Refining	(n.a.)	(1.14)	(.97)	(.13)	(.81)	(.75)
	30	Rubber and Plastics	(n.a.)	(4.14)	(4.59)	(4.63)	(4.64)	(4.62)
	21, 31	Tobacco and Leather	(n.a.)	(2.71)	(2.37)	(2.12)	(2.00)	(1.87)
E.	40-49	Transportation, Communications, and Utilities	36.00	37.12	39.47	40.78	44.25	46.79
F.	50-59	Wholesale and Retail Trade	87.60	101.69	115.70	117.89	127.46	134.72
G.	60-67	Finance, Insurance, and Real Estate	20.90	27.13	33.55	36.39	40.21	43.50
H.	70-89	Services	88.80	111.51	134.36	160.18	187.04	233.27
I.		Government	18.00	21.29	26.91	34.54	44.62	54.74
		Nonclassified	26.80	15.71	18.51	20.65	23.16	25.70
TOTAL EMPLOYMENT			478.10	513.99	577.68	629.47	702.88	786.30
Unemployment			23.66	21.25	25.19	28.88	33.84	39.63
Civilian Labor Force			501.76	535.24	602.87	658.35	736.72	825.93
Armed Forces			.62	.59	.55	.53	.52	.50
TOTAL LABOR FORCE			502.38	535.83	603.42	658.88	737.24	826.43
TOTAL POPULATION			1309.60	1398.96	1565.91	1729.54	1885.63	2052.40

TABLE II-5L

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010
SUBAREA: L - LITTLE MIAMI-MIAMI
(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	28.14	18.41	13.66	11.97	11.27	11.40
B.		Mining	.90	.94	1.07	1.16	1.30	1.40
	12	Coal Mining	--	--	--	--	--	--
	10, 13, 14	Other Mining	.90	.94	1.07	1.16	1.30	1.40
C.	15-17	Construction	25.10	27.10	31.12	42.32	55.89	64.64
D.		Manufacturing	195.10	217.88	240.28	249.74	267.84	282.46
	24-25	Lumber and Furniture	3.76	4.11	4.73	5.37	6.31	7.24
	33	Primary Metals	13.63	11.67	10.00	8.74	8.10	7.64
	34	Fabricated Metals	12.31	15.74	19.34	23.52	29.19	35.38
	35-36	Machinery and Electrical Machinery	77.13	90.52	104.20	109.43	117.90	122.78
	37 except 371	Transportation Equipment	7.29	9.57	11.13	10.92	10.58	10.31
	371	Motor Vehicles	16.67	15.67	13.67	10.86	8.63	6.74
	19, 32, 38-39	Other Durables	8.44	10.78	13.07	14.80	17.06	19.01
	20	Food	10.78	10.08	9.83	9.46	9.27	8.97
	22	Textiles	2.00	1.76	1.79	1.74	1.78	1.78
	23	Apparel	1.58	1.18	.78	.26	.16	.10
	27	Printing	14.38	16.63	18.65	19.78	21.47	22.96
	28	Chemicals	4.15	3.77	3.73	3.49	3.29	3.01
		Other Nondurables	23.24	26.40	29.36	31.37	34.10	36.54
	26	Paper	(n.a.)	(15.39)	(17.11)	(18.29)	(19.88)	(21.29)
	29	Petroleum Refining	(n.a.)	(.36)	(.40)	(.43)	(.47)	(.50)
	30	Rubber and Plastics	(n.a.)	(10.31)	(11.47)	(12.26)	(13.32)	(14.27)
	21, 31	Tobacco and Leather	(n.a.)	(.34)	(.38)	(.40)	(.44)	(.47)
E.	40-49	Transportation, Communications, and Utilities	23.50	24.38	26.75	28.39	31.57	34.11
F.	50-59	Wholesale and Retail Trade	83.10	95.17	112.12	117.57	130.50	141.06
G.	60-67	Finance, Insurance, and Real Estate	14.40	17.29	21.80	24.03	26.95	29.53
H.	70-89	Services	92.10	111.03	138.81	170.78	205.24	262.74
I.		Government	35.10	46.73	64.40	88.49	120.91	155.73
		Nonclassified	19.90	13.87	16.23	18.42	21.48	24.94
		TOTAL EMPLOYMENT	514.40	572.80	666.24	752.87	872.95	1008.01
		Unemployment	25.42	23.65	29.03	34.54	42.03	50.80
		Civilian Labor Force	539.80	596.45	695.27	787.41	914.98	1058.81
		Armed Forces	6.46	6.13	5.75	5.53	5.37	5.22
		TOTAL LABOR FORCE	546.26	602.58	701.02	792.94	920.35	1064.03
		TOTAL POPULATION	1419.00	1571.78	1817.29	2078.03	2352.07	2642.47

TABLE II-5M

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010
SUBAREA: M - LICKING-KENTUCKY-SALT
(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	46.63	32.35	23.38	20.05	18.53	18.50
B.		Mining	9.70	8.03	6.57	5.40	4.63	4.04
	12	Coal Mining	8.52	6.39	4.63	3.26	2.24	1.46
	10, 13, 14	Other Mining	1.18	1.64	1.94	2.14	2.39	2.58
C.	15-17	Construction	15.10	19.05	23.98	32.92	45.73	56.59
D.		Manufacturing	33.80	44.28	57.91	70.94	87.24	107.21
	24-25	Lumber and Furniture	2.93	4.88	6.36	8.04	10.32	12.80
	33	Primary Metals	.43	.40	.42	.42	.45	.42
	34	Fabricated Metals	1.22	1.66	2.37	3.25	4.36	5.67
	35-36	Machinery and Electrical Machinery	8.47	12.05	18.45	24.18	31.34	41.44
	37 except 371	Transportation Equipment	.33	.39	.43	.40	.37	.35
	371	Motor Vehicles	.69	.84	1.04	1.11	1.15	1.19
	19, 32, 38-39	Other Durables	2.72	3.15	3.87	4.44	5.14	5.79
	20	Food	6.51	6.20	6.10	5.92	5.83	5.67
	22	Textiles	.12	.20	.18	.17	.16	.15
	23	Apparel	5.38	8.25	11.22	14.64	18.70	23.36
	27	Printing	1.90	2.22	2.58	2.82	3.12	3.42
	28	Chemicals	.31	.47	.54	.57	.60	.60
		Other Nondurables	2.66	3.57	4.35	4.98	5.70	6.35
	26	Paper	(n.a.)	(.18)	(.22)	(.25)	(.29)	(.32)
	29	Petroleum Refining	(n.a.)	(--)	(--)	(--)	(--)	(--)
	30	Rubber and Plastics	(n.a.)	(1.21)	(1.48)	(1.69)	(1.93)	(2.16)
	21, 31	Tobacco and Leather	(n.a.)	(2.18)	(2.67)	(3.04)	(3.48)	(3.88)
E.	40-49	Transportation, Communications, and Utilities	11.20	11.49	12.19	12.61	13.64	14.50
F.	50-59	Wholesale and Retail Trade	35.50	41.66	49.61	52.47	58.64	63.80
G.	60-67	Finance, Insurance, and Real Estate	5.30	6.32	8.09	9.03	10.21	11.29
H.	70-89	Services	49.50	62.82	77.44	94.22	112.00	142.38
I.		Government	10.90	14.22	19.12	25.77	34.68	44.11
		Nonclassified	6.10	6.40	7.50	8.64	10.20	12.10
TOTAL EMPLOYMENT			225.60	246.62	285.78	332.05	395.50	474.52
		Unemployment	13.52	11.82	13.88	16.34	19.70	23.92
Civilian Labor Force			239.12	258.44	299.66	348.39	415.20	498.44
		Armed Forces	.27	.26	.24	.23	.23	.22
TOTAL LABOR FORCE			239.39	258.70	299.90	348.62	415.43	498.66
TOTAL POPULATION			722.70	759.14	850.99	970.61	1095.92	1238.40

TABLE II-5N

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010
SUBAREA: N - OHIO-LOUISVILLE
(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	11.89	8.12	5.88	5.03	4.67	4.65
B.		Mining	.40	.92	1.08	1.18	1.33	1.43
	12	Coal Mining	--	--	--	--	--	--
	10, 13, 14	Other Mining	.40	.92	1.08	1.18	1.33	1.43
C.	15-17	Construction	17.40	21.43	26.04	36.82	50.32	61.85
D.		Manufacturing	88.40	108.38	127.48	142.64	163.25	182.27
	24-25	Lumber and Furniture	7.12	9.27	10.98	12.86	15.43	18.18
	33	Primary Metals	1.22	1.08	.77	.55	.45	.36
	34	Fabricated Metals	9.26	10.61	12.04	13.76	16.28	18.87
	35-36	Machinery and Electrical Machinery	19.14	28.20	40.49	51.04	64.34	76.98
	37 except 371	Transportation Equipment	.61	.25	.21	.13	.07	.03
	371	Motor Vehicles	3.19	3.18	3.08	2.72	2.44	2.17
	19, 32, 38-39	Other Durables	4.20	5.39	6.25	6.86	7.74	8.47
	20	Food	14.30	15.88	15.70	15.26	15.09	14.71
	22	Textiles	.60	.53	.38	.26	.17	.08
	23	Apparel	2.70	2.68	2.45	2.09	1.65	1.05
	27	Printing	6.60	7.92	8.93	9.53	10.38	11.15
	28	Chemicals	8.78	10.75	12.24	12.76	13.18	13.12
		Other Nondurables	10.43	12.64	13.96	14.82	16.03	17.10
	26	Paper	(n.a.)	(2.40)	(3.07)	(3.56)	(4.01)	(4.36)
	29	Petroleum Refining	(n.a.)	(.26)	(.29)	(.30)	(.33)	(.35)
	30	Rubber and Plastics	(n.a.)	(.28)	(.38)	(.47)	(.59)	(.72)
	21, 31	Tobacco and Leather	(n.a.)	(9.70)	(10.23)	(10.49)	(11.10)	(11.67)
E.	40-49	Transportation, Communications, and Utilities	23.80	26.35	28.69	30.15	33.26	35.66
F.	50-59	Wholesale and Retail Trade	56.60	62.56	72.62	75.14	82.59	88.21
G.	60-67	Finance, Insurance, and Real Estate	12.30	15.29	18.98	20.62	22.84	24.76
H.	70-89	Services	57.30	72.71	88.86	107.18	126.56	159.78
I.		Government	12.70	16.55	21.65	28.59	37.88	47.49
		Nonclassified	14.70	12.06	14.66	16.69	18.72	20.89
TOTAL EMPLOYMENT			293.00	344.37	405.94	464.04	541.42	626.99
Unemployment			17.56	16.51	19.71	22.84	26.97	31.60
Civilian Labor Force			310.56	360.88	425.65	486.88	568.39	658.59
Armed Forces			3.45	3.27	3.07	2.95	2.87	2.79
TOTAL LABOR FORCE			314.01	364.15	428.72	489.83	571.26	661.38
TOTAL POPULATION			852.60	983.39	1141.57	1306.19	1473.62	1642.50

TABLE II-5O

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010

SUBAREA: O - LOWER OHIO-EVANSVILLE

(in thousands of people)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	19.41	13.57	9.66	8.18	7.48	7.41
B.		Mining	6.10	10.18	11.94	13.15	14.44	15.62
	12	Coal Mining	2.93	4.71	5.38	5.86	6.27	6.83
	10, 13, 14	Other Mining	3.17	5.47	6.56	7.29	8.17	8.79
C.	15-17	Construction	11.50	15.23	19.15	27.22	37.68	47.23
D.		Manufacturing	48.10	54.93	60.61	63.75	68.90	73.37
	24-25	Lumber and Furniture	5.85	7.02	8.27	9.63	11.53	13.53
	33	Primary Metals	1.02	.97	.94	.90	.91	.91
	34	Fabricated Metals	3.29	6.13	9.06	12.36	16.63	21.45
	35-36	Machinery and Electrical Machinery	14.05	16.54	16.72	15.09	13.46	11.09
	37 except 371	Transportation Equipment	.87	.93	.96	.85	.75	.68
	371	Motor Vehicles	1.02	.25	.21	.14	.09	.04
	19, 32, 38-39	Other Durables	2.14	2.09	2.20	2.25	2.41	2.52
	20	Food	6.56	6.38	5.91	5.41	5.09	4.73
	22	Textiles	1.47	1.61	1.69	1.69	1.77	1.81
	23	Apparel	2.13	2.01	1.96	1.85	1.71	1.48
	27	Printing	2.15	2.40	2.66	2.78	2.99	3.15
	28	Chemicals	3.92	4.71	5.86	6.47	6.97	7.17
		Other Nondurables	3.62	3.89	4.17	4.33	4.59	4.81
	26	Paper	(n.a.)	(.29)	(.19)	(.13)	(.09)	(.07)
	29	Petroleum Refining	(n.a.)	(.12)	(.08)	(.06)	(.06)	(.05)
	30	Rubber and Plastics	(n.a.)	(2.43)	(2.98)	(3.31)	(3.66)	(3.92)
	21, 31	Tobacco and Leather	(n.a.)	(1.05)	(.92)	(.82)	(.78)	(.77)
E.	40-49	Transportation, Communications, and Utilities	14.00	15.15	16.55	17.48	19.32	20.78
F.	50-59	Wholesale and Retail Trade	35.70	43.66	51.47	53.93	59.89	64.76
G.	60-67	Finance, Insurance, and Real Estate	5.10	6.35	7.93	8.68	9.66	10.52
H.	70-89	Services	36.00	46.17	56.53	68.55	81.20	102.61
I.		Government	5.70	6.91	8.59	10.81	13.74	16.65
		Nonclassified	6.40	3.59	3.91	4.39	5.10	6.00
TOTAL EMPLOYMENT			187.10	215.74	246.34	276.14	317.41	364.95
		Unemployment	12.61	11.36	12.84	14.23	16.17	18.39
Civilian Labor Force			199.71	227.10	259.18	290.37	333.58	383.34
		Armed Forces	.28	.27	.25	.24	.23	.23
TOTAL LABOR FORCE			199.99	227.37	259.43	290.61	333.81	383.57
TOTAL POPULATION			559.20	627.48	701.08	784.75	867.00	952.58

TABLE II-5P

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010

SUBAREA: P - GREEN

(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	30.14	21.09	15.35	13.23	12.28	12.32
B.		Mining	6.30	6.05	5.74	5.48	5.39	5.42
	12	Coal Mining	5.35	4.76	4.22	3.80	3.51	3.40
	10, 13, 14	Other Mining	.95	1.29	1.52	1.68	1.88	2.02
C.	15-17	Construction	7.30	10.01	13.42	19.19	27.27	35.09
D.		Manufacturing	16.40	21.49	28.48	35.66	44.57	54.15
	24-25	Lumber and Furniture	2.50	3.44	4.42	5.51	6.99	8.61
	33	Primary Metals	.36	.43	.48	.48	.50	.48
	34	Fabricated Metals	.21	.33	.46	.62	.86	1.10
	35-36	Machinery and Electrical Machinery	2.41	3.40	5.11	6.72	8.66	10.57
	37 except 371	Transportation Equipment	.02	.04	.06	.06	.06	.06
	371	Motor Vehicles	.39	.48	.61	.67	.70	.72
	19, 32, 38-39	Other Durables	.57	.67	.79	.89	1.02	1.13
	20	Food	2.32	1.57	1.55	1.51	1.49	1.46
	22	Textiles	.38	.41	.48	.51	.57	.60
	23	Apparel	5.43	8.17	11.55	15.46	20.12	25.52
	27	Printing	.64	1.22	1.42	1.54	1.71	1.87
	28	Chemicals	.27	.32	.38	.41	.43	.43
		Other Nondurables	.77	1.01	1.17	1.31	1.46	1.60
	26	Paper	(n.a.)	(.36)	(.42)	(.47)	(.53)	(.58)
	29	Petroleum Refining	(n.a.)	(--)	(--)	(--)	(--)	(--)
	30	Rubber and Plastics	(n.a.)	(--)	(--)	(--)	(--)	(--)
	21, 31	Tobacco and Leather	(n.a.)	(.65)	(.75)	(.84)	(.93)	(1.02)
E.	40-49	Transportation, Communications, and Utilities	5.00	5.34	5.94	6.36	7.06	7.64
F.	50-59	Wholesale and Retail Trade	19.00	22.23	26.90	28.99	33.07	36.13
G.	60-67	Finance, Insurance, and Real Estate	2.10	2.41	3.18	3.58	4.11	4.60
H.	70-89	Services	19.70	25.76	32.14	39.57	47.60	60.72
I.		Government	4.60	7.65	9.86	12.86	16.87	20.86
		Nonclassified	3.30	2.79	3.23	3.75	4.46	5.24
TOTAL EMPLOYMENT			115.50	124.82	144.24	168.67	202.68	242.17
Unemployment			6.60	5.76	6.81	8.15	10.00	12.21
Civilian Labor Force			122.10	130.58	151.05	176.82	212.68	254.38
Armed Forces			24.31	23.08	21.65	20.80	20.23	19.66
TOTAL LABOR FORCE			146.41	153.66	172.70	197.62	232.91	274.04
TOTAL POPULATION			393.10	409.40	456.63	524.02	598.03	680.56

TABLE II-5Q

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010

SUBAREA: Q - WHITE

(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	35.46	23.70	17.04	14.53	13.38	13.31
B.		Mining	4.00	6.44	8.33	8.42	9.23	9.97
	12	Coal Mining	1.71	2.75	3.09	3.32	3.52	3.82
	10, 13, 14	Other Mining	2.29	3.69	4.24	5.10	5.71	6.15
C.	15-17	Construction	34.60	40.09	47.56	67.25	90.89	109.88
D.		Manufacturing	221.70	262.76	304.98	332.02	372.72	410.34
	24-25	Lumber and Furniture	11.87	14.83	17.97	21.41	26.16	31.22
	33	Primary Metals	9.51	7.37	6.19	5.35	4.94	4.61
	34	Fabricated Metals	14.46	16.31	18.32	20.74	24.33	28.04
	35-36	Machinery and Electrical Machinery	69.65	95.88	127.90	152.81	185.01	214.58
	37 except 371	Transportation Equipment	13.44	19.15	22.54	22.34	21.79	21.38
	371	Motor Vehicles	25.72	26.68	26.36	23.83	21.76	19.76
	19, 32, 38-39	Other Durables	16.37	16.27	17.04	17.29	18.25	18.92
	20	Food	20.43	20.67	19.81	18.74	18.12	17.31
	22	Textiles	.57	.20	.10	.05	.02	.01
	23	Apparel	3.93	2.95	1.81	.36	.16	.10
	27	Printing	11.82	13.40	15.01	15.91	17.27	18.45
	28	Chemicals	10.42	12.26	13.45	13.62	13.77	13.45
		Other Nondurables	13.81	16.79	18.48	19.57	21.14	22.51
	26	Paper	(n.a.)	(7.56)	(8.13)	(8.51)	(9.09)	(9.57)
	29	Petroleum Refining	(n.a.)	(.57)	(.62)	(.66)	(.71)	(.76)
	30	Rubber and Plastics	(n.a.)	(6.62)	(7.48)	(8.01)	(8.76)	(9.44)
	21, 31	Tobacco and Leather	(n.a.)	(2.05)	(2.25)	(2.38)	(2.57)	(2.74)
E.	40-49	Transportation, Communications, and Utilities	41.90	44.57	48.45	50.97	56.26	60.32
F.	50-59	Wholesale and Retail Trade	121.30	141.22	166.24	174.25	193.43	208.90
G.	60-67	Finance, Insurance, and Real Estate	26.80	33.14	41.84	46.16	51.78	56.80
H.	70-89	Services	121.40	150.30	185.66	226.37	269.64	342.28
I.		Government	29.60	36.41	47.61	62.87	83.16	104.29
		Nonclassified	29.20	17.55	20.66	23.29	26.60	30.17
TOTAL EMPLOYMENT			671.50	756.18	888.37	1006.13	1167.09	1346.26
Unemployment			29.60	28.71	36.50	44.44	55.19	67.85
Civilian Labor Force			701.10	784.89	924.87	1050.57	1222.28	1414.11
Armed Forces			3.39	3.32	3.02	2.90	2.82	2.74
TOTAL LABOR FORCE			704.49	788.21	927.89	1053.47	1225.10	1416.85
			1782.90	2012.04	2366.16	2733.70	3116.06	3518.68

TABLE II-5R

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010

SUBAREA: R - WABASH

(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	59.00	38.94	28.67	24.95	23.36	23.58
B.		Mining	7.00	11.08	15.08	17.94	20.63	23.24
	12	Coal Mining	1.25	5.61	8.84	11.18	13.06	15.09
	10, 13, 14	Other Mining	5.75	5.47	6.24	6.76	7.57	8.15
C.	15-17	Construction	24.20	29.32	33.16	44.51	58.76	66.71
D.		Manufacturing	131.40	148.43	171.61	188.53	212.11	233.81
	24-25	Lumber and Furniture	6.32	8.18	9.98	11.95	14.67	17.59
	33	Primary Metals	16.28	13.63	12.10	10.89	10.31	9.91
	34	Fabricated Metals	7.59	8.15	8.80	9.61	10.84	12.10
	35-36	Machinery and Electrical Machinery	30.31	41.56	57.70	71.11	88.03	104.02
	37 except 371	Transportation Equipment	1.58	1.28	1.48	1.45	1.40	1.36
	371	Motor Vehicles	10.63	12.42	13.79	13.73	13.59	13.26
	19, 32, 38-39	Other Durables	11.48	11.02	11.78	12.15	13.02	13.69
	20	Food	12.82	10.75	9.72	8.73	8.05	7.35
	22	Textiles	.19	.22	.20	.17	.15	.14
	23	Apparel	5.25	5.06	4.52	3.77	2.77	1.52
	27	Printing	10.57	13.56	16.29	18.26	20.73	23.03
	28	Chemicals	5.01	6.25	7.40	7.92	8.36	8.45
		Other Nondurables	13.82	16.35	17.85	18.79	20.19	21.39
	26	Paper	(n.a.)	(4.49)	(4.91)	(5.17)	(5.55)	(5.88)
	29	Petroleum Refining	(n.a.)	(1.75)	(1.91)	(2.01)	(2.16)	(2.29)
	30	Rubber and Plastics	(n.a.)	(6.18)	(6.84)	(7.29)	(7.94)	(8.52)
	21, 31	Tobacco and Leather	(n.a.)	(3.92)	(4.19)	(4.32)	(4.54)	(4.71)
E.	40-49	Transportation, Communications, and Utilities	33.70	36.35	38.73	40.12	43.65	46.21
F.	50-59	Wholesale and Retail Trade	86.80	103.68	120.99	125.99	138.90	149.32
G.	60-67	Finance, Insurance, and Real Estate	12.70	15.26	18.72	20.16	22.14	23.82
H.	70-89	Services	103.90	133.02	165.53	203.05	242.76	309.97
I.		Government	16.10	21.26	27.07	34.95	45.42	56.06
		Nonclassified	14.70	11.01	12.55	14.06	16.04	18.48
		TOTAL EMPLOYMENT	487.80	548.35	632.11	714.26	823.77	951.20
		Unemployment	23.80	22.42	27.35	32.63	39.58	47.94
		Civilian Labor Force	511.60	570.77	659.46	746.89	863.35	999.14
		Armed Forces	13.94	13.24	12.42	11.93	11.60	11.27
		TOTAL LABOR FORCE	525.54	584.01	671.88	758.82	874.95	1010.41
		TOTAL POPULATION	1362.40	1518.29	1738.87	1990.26	2234.75	2509.30

TABLE II-5S

EMPLOYMENT, LABOR FORCE, AND POPULATION, 1960-2010

SUBAREA: S - CUMBERLAND

(in thousands of persons)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	52.90	36.64	26.14	22.16	20.29	20.08
B.		Mining	8.30	4.97	4.03	3.34	2.81	2.43
	12	Coal Mining	7.34	4.00	2.89	2.08	1.40	.91
	10, 13, 14	Other Mining	.96	.97	1.14	1.26	1.41	1.52
C.	15-17	Construction	26.80	33.42	42.14	58.98	82.12	101.90
D.		Manufacturing	83.10	102.33	125.09	146.86	175.00	205.86
	24-25	Lumber and Furniture	10.77	14.30	17.68	21.43	26.53	32.08
	33	Primary Metals	.55	.27	.22	.18	.15	.14
	34	Fabricated Metals	4.28	6.35	8.52	10.98	14.21	17.88
	35-36	Machinery and Electrical Machinery	7.07	9.75	14.44	18.57	23.78	28.80
	37 except 371	Transportation Equipment	1.53	2.13	2.73	2.87	2.92	2.97
	371	Motor Vehicles	1.02	1.28	1.51	1.57	1.62	1.62
	19, 32, 38-39	Other Durables	5.94	6.61	8.17	9.37	10.90	12.24
	20	Food	9.20	10.06	10.25	10.19	10.26	10.16
	22	Textiles	3.73	3.89	3.93	3.82	3.90	3.90
	23	Apparel	16.55	22.04	30.12	39.46	50.51	63.25
	27	Printing	7.49	9.08	10.71	11.84	13.29	14.63
	28	Chemicals	5.02	4.06	2.71	1.37	.27	.22
		Other Nondurables	10.02	12.51	14.10	15.21	16.66	17.97
	26	Paper	(n.a.)	(1.05)	(1.19)	(1.28)	(1.40)	(1.51)
	29	Petroleum Refining	(n.a.)	(.31)	(.39)	(.46)	(.54)	(.63)
	30	Rubber and Plastics	(n.a.)	(1.28)	(1.45)	(1.58)	(1.75)	(1.90)
	21, 31	Tobacco and Leather	(n.a.)	(9.87)	(11.07)	(11.89)	(12.97)	(13.92)
E.	40-49	Transportation, Communications, and Utilities	23.90	26.92	29.64	31.52	35.14	38.06
F.	50-59	Wholesale and Retail Trade	68.00	81.46	97.97	104.29	117.27	128.18
G.	60-67	Finance, Insurance, and Real Estate	13.30	16.39	21.10	23.68	26.91	29.87
H.	70-89	Services	85.00	110.09	137.65	169.60	203.84	260.97
I.		Government	15.70	19.83	26.00	34.33	45.48	57.05
		Nonclassified	12.30	10.54	12.48	14.55	17.33	20.53
TOTAL EMPLOYMENT			390.20	442.59	522.24	609.31	726.19	864.93
		Unemployment	20.31	19.01	23.41	28.45	35.26	43.59
Civilian Labor Force			410.51	1161.60	345.65	637.76	761.45	908.52
		Armed Forces	22.01	20.89	19.60	18.83	18.31	17.80
TOTAL LABOR FORCE			432.52	482.49	565.25	656.59	779.76	926.32
TOTAL POPULATION			1219.20	1343.42	1533.62	1776.00	2025.87	2300.47

TABLE II-6

OUTPUT BY INDUSTRY, 1960-2010
FOR OHIO RIVER BASIN SUBAREAS

(This table, which begins on the next page, consists of 19 panels, one for each subarea. The data were derived from Table II in Appendix H and Table I in Appendix I.)

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TABLE II-6A

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: A - ALLEGHENY

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	133.5	129.5	129.3	140.3	152.8	171.8
B.		Mining	191.0	235.4	301.3	389.1	518.5	682.4
	12	Coal Mining	94.5	137.9	194.9	267.3	352.1	458.8
	10, 13, 14	Other Mining	96.5	97.4	106.4	121.8	166.4	223.6
C.	15-17	Construction	248.2	381.4	534.2	727.7	1030.7	1364.0
D.		Manufacturing	2000.8	2754.5	3696.1	4818.5	6553.8	8760.7
	24-25	Lumber and Furniture	59.7	83.5	114.9	154.8	214.2	288.4
	33	Primary Metals	593.4	667.9	746.9	852.5	1022.6	1237.4
	34	Fabricated Metals	170.2	285.9	428.2	621.9	910.4	1291.9
	35-36	Machinery and Electrical Machinery	321.7	575.6	921.7	1322.0	1920.3	2673.8
	37 except 371	Transportation Equipment	37.5	50.1	71.0	87.2	106.3	131.6
	371	Motor Vehicles	15.7	27.5	45.2	67.2	98.2	142.0
	19, 32, 38-39	Other Durables	235.9	333.7	466.5	628.6	877.0	1198.4
	20	Food	178.3	242.1	315.6	408.5	541.1	707.7
	22	Textiles	2.6	3.3	2.3	.8	.7	.4
	23	Apparel	53.1	95.4	145.6	212.3	302.9	422.5
	27	Printing	38.1	53.3	76.5	103.7	143.6	195.2
	28	Chemicals	92.9	96.8	80.0	36.3	44.2	48.6
		Other Nondurables	201.7	239.4	281.7	322.7	372.3	422.8
	26	Paper	(NA)	(44.1)	(52.0)	(59.5)	(68.6)	(78.0)
	29	Petroleum Refining	(NA)	(111.8)	(131.4)	(150.6)	(173.8)	(197.3)
	30	Rubber and Plastics	(NA)	(37.1)	(42.3)	(46.8)	(52.1)	(57.1)
	21,31	Tobacco and Leather	(NA)	(46.4)	(56.0)	(65.8)	(77.8)	(90.4)

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TABLE II-6B

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: B - MONONGAHELA
(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	87.1	85.4	80.3	82.4	85.3	91.7
B.		Mining	226.6	302.8	392.3	491.4	597.0	712.1
	12	Coal Mining	195.0	263.7	342.9	429.3	512.2	598.1
	10, 13, 14	Other Mining	31.6	39.1	49.4	62.1	84.8	114.0
C.	15-17	Construction	177.2	387.8	405.33	564.3	813.2	1098.9
D.		Manufacturing	674.6	966.2	1309.9	1700.9	2262.9	2962.2
	24-25	Lumber and Furniture	41.5	53.8	71.0	92.0	123.3	161.5
	33	Primary Metals	131.0	181.2	231.4	284.2	348.1	424.8
	34	Fabricated Metals	48.9	62.3	78.9	98.8	130.1	168.4
	35-36	Machinery and Electrical Machinery	73.4	124.7	210.4	309.9	463.8	660.7
	37 except 371	Transportation Equipment	5.0	11.1	19.1	27.2	38.1	53.9
	371	Motor Vehicles	9.7	35.9	61.3	92.9	138.8	202.2
	19, 32, 38-39	Other Durables	167.9	214.6	268.9	328.1	417.9	523.4
	20	Food	102.2	104.4	131.7	166.2	213.4	272.6
	22	Textiles	3.2	4.0	5.4	6.9	9.4	12.3
	23	Apparel	24.9	43.5	67.2	98.8	141.9	199.3
	27	Printing	20.3	26.4	36.9	48.7	66.2	88.6
	28	Chemicals	24.7	56.5	65.6	68.9	70.6	63.2
		Other Nondurables	21.9	47.8	62.1	78.3	101.3	131.3
	26	Paper	(NA)	(17.9)	(23.2)	(29.3)	(37.9)	(49.1)
	29	Petroleum Refining	(NA)	(10.6)	(13.7)	(17.2)	(22.2)	(28.6)
	30	Rubber and Plastics	(NA)	(-)	(-)	(-)	(-)	(-)
	21,31	Tobacco and Leather	(NA)	(19.3)	(25.2)	(31.8)	(41.2)	(53.6)

TABLE II-6C

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: C - PITTSBURGH SMSA

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	83.0	77.9	78.4	86.0	93.8	106.0
B.		Mining	137.6	178.7	232.2	296.2	379.9	480.2
	12	Coal Mining	87.9	122.5	165.2	214.8	268.7	330.8
	10, 13, 14	Other Mining	49.7	56.2	67.0	81.4	111.2	149.4
C.	15-17	Construction	857.3	1220.2	1695.9	2291.9	3208.7	4224.7
D.		Manufacturing	7676.9	9395.7	11346.0	13565.6	16933.3	21046.6
	24-25	Lumber and Furniture	40.3	38.8	43.9	48.4	54.5	59.3
	33	Primary Metals	3651.2	4014.0	4243.2	4616.3	5312.0	6198.0
	34	Fabricated Metals	629.0	902.6	1233.9	1677.0	2338.5	3188.9
	35-36	Machinery and Electrical Machinery	1024.9	1303.6	1669.1	1936.4	2284.5	2575.7
	37 except 371	Transportation Equipment	170.9	249.7	256.5	191.0	79.0	43.5
	371	Motor Vehicles	120.8	202.9	326.0	470.3	676.7	959.6
	19, 32, 38-39	Other Durables	427.9	585.5	764.9	971.3	1285.3	1676.0
	20	Food	857.0	1069.4	1382.3	1771.6	2326.2	3027.9
	22	Textiles	6.0	8.9	10.2	11.3	13.3	15.3
	23	Apparel	22.4	31.4	41.6	54.0	70.4	90.4
	27	Printing	157.6	211.4	296.7	394.4	586.9	720.5
	28	Chemicals	341.5	546.9	823.9	1156.7	1630.0	2226.7
		Other Nondurables	227.4	230.6	253.8	266.9	276.0	264.8
	26	Paper	(NA)	(141.8)	(156.6)	(165.2)	(171.4)	(165.0)
	29	Petroleum Refining	(NA)	(19.6)	(19.0)	(17.4)	(15.2)	(11.9
	30	Rubber and Plastics	(NA)	(69.2)	(78.2)	(84.3)	(89.4)	(87.9)
	21, 31	Tobacco and Leather	(NA)	(-)	(-)	(-)	(-)	(-)

TABLE II-6D

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: D - BEAVER

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	65.4	57.2	55.6	58.4	61.8	67.7
B.		Mining						
	12	Coal Mining	41.3	40.6	56.8	76.3	101.4	132.4
	10, 13, 14	Other Mining	20.2	29.2	41.2	56.0	73.6	95.1
			21.1	11.4	15.6	20.3	27.8	37.3
C.	15-17	Construction	305.6	413.5	601.0	845.3	1226.1	1663.4
D.		Manufacturing	3196.2	3925.2	4899.5	6051.0	7871.6	10188.5
	24-25	Lumber and Furniture	45.7	86.8	131.5	191.0	279.7	396.6
	33	Primary Metals	1721.5	1829.0	1981.3	2198.3	2578.3	3066.5
	34	Fabricated Metals	272.7	340.5	417.2	517.8	667.5	848.5
	35-36	Machinery and Electrical Machinery	448.0	693.6	1013.9	1346.7	1832.2	2405.4
	37 except 371	Transportation Equipment	106.7	91.9	75.1	23.2	12.9	8.5
	371	Motor Vehicles	81.7	153.7	261.5	393.0	584.7	847.7
	19, 32, 38-39	Other Durables	120.8	182.9	243.4	313.5	421.0	556.3
	20	Food	166.2	217.6	296.6	399.0	547.6	742.5
	22	Textiles	4.2	6.3	9.6	13.5	19.6	27.3
	23	Apparel	8.2	5.5	2.4	1.3	1.0	.7
	27	Printing	41.4	61.0	92.6	131.4	189.0	265.8
	28	Chemicals	52.5	83.5	127.6	181.7	259.6	357.3
		Other Nondurables	126.6	172.9	246.8	341.6	478.5	665.4
	26	Paper	(NA)	(31.3)	(46.9)	(66.6)	(95.7)	(136.4)
	29	Petroleum Refining	(NA)	(8.5)	(9.9)	(12.0)	(14.4)	(16.6)
	30	Rubber and Plastics	(NA)	(115.8)	(167.8)	(234.0)	(330.1)	(462.4)
	21, 31	Tobacco and Leather	(NA)	(17.3)	(22.2)	(29.0)	(38.3)	(50.0)

TABLE II-6E

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: E - UPPER OHIO

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	96.1	106.03	103.2	108.4	115.0	126.9
B.		Mining	134.1	204.2	300.6	427.4	602.0	834.1
	12	Coal Mining	69.4	113.8	178.3	268.1	384.5	541.8
	10, 13, 14	Other Mining	64.7	90.4	122.3	159.3	217.5	292.3
C.	15-17	Construction	256.8	361.0	512.5	705.9	1005.5	1346.9
D.		Manufacturing	2087.3	2463.5	3010.2	3599.2	4477.1	5494.5
	24-25	Lumber and Furniture	25.4	37.5	50.2	65.7	88.9	118.1
	33	Primary Metals	948.9	1067.8	1207.3	1384.0	1656.7	1988.7
	34	Fabricated Metals	157.8	201.9	254.2	322.9	425.7	551.8
	35-36	Machinery and Electrical Machinery	135.7	204.2	316.6	441.6	628.6	856.9
	37 except 371	Transportation Equipment	3.4	3.1	4.1	4.5	4.8	4.7
	371	Motor Vehicles	9.0	11.6	16.9	21.3	28.1	36.6
	19, 32, 38-39	Other Durables	228.6	260.2	272.9	267.4	256.0	213.1
	20	Food	157.9	172.8	217.1	270.7	347.1	437.9
	22	Textiles	1.1	3.9	.4	.3	.2	.1
	23	Apparel	11.7	14.5	19.7	26.7	36.2	48.1
	27	Printing	41.8	59.1	85.0	115.1	159.9	218.0
	28	Chemicals	269.0	325.7	434.0	541.4	683.4	836.2
		Other Nondurables	97.0	101.2	131.8	137.6	161.5	184.3
	26	Paper	(NA)	(30.4)	(31.3)	(28.2)	(28.2)	(26.8)
	29	Petroleum Refining	(NA)	(8.1)	(10.9)	(11.7)	(14.1)	(16.2)
	30	Rubber and Plastics	(NA)	(17.2)	(23.7)	(25.5)	(30.3)	(35.1)
	21, 31	Tobacco and Leather	(NA)	(45.5)	(65.9)	(72.2)	(88.9)	(106.2)

TABLE II-6F

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: F - MUSKINGUM

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	244.9	254.3	261.9	290.9	323.3	371.5
B.		Mining	158.9	217.7	294.3	387.7	513.7	672.1
	12	Coal Mining	85.7	123.3	171.8	231.7	300.6	385.8
	10, 13, 14	Other Mining	73.2	94.4	122.5	156.0	213.1	286.3
C.	15-17	Construction	378.8	539.9	779.6	1089.3	1572.8	2125.2
D.		Manufacturing	3301.4	4878.3	6817.0	9145.4	12673.0	17239.6
	24-25	Lumber and Furniture	40.9	54.5	75.9	103.4	144.1	196.1
	33	Primary Metals	680.1	849.1	925.4	1031.4	1215.3	1447.0
	34	Fabricated Metals	315.9	491.6	665.5	898.9	1245.3	1690.3
	35-36	Machinery and Electrical Machinery	728.8	1279.9	2015.7	2852.5	4101.3	5662.5
	37 except 371	Transportation Equipment	50.3	71.3	102.1	126.0	155.3	194.0
	371	Motor Vehicles	240.0	387.3	665.8	1008.9	1506.0	2199.0
	19, 32, 38-39	Other Durables	380.8	485.0	617.7	765.4	990.2	1262.8
	20	Food	322.7	465.8	670.4	940.4	1334.5	1859.1
	22	Textiles	3.1	5.2	7.0	9.0	12.2	16.3
	23	Apparel	12.0	16.4	22.1	29.4	38.9	51.1
	27	Printing	71.0	92.3	125.9	163.5	217.0	285.1
	28	Chemicals	74.5	96.8	80.0	36.3	44.2	48.6
		Other Nondurables	381.4	583.1	843.5	1180.3	1668.7	2327.7
	26	Paper	(NA)	(145.8)	(168.7)	(194.8)	(242.0)	(314.2)
	29	Petroleum Refining	(NA)	(52.5)	(92.8)	(147.5)	(225.3)	(331.7)
	30	Rubber and Plastics	(NA)	(384.8)	(582.0)	(838.0)	(1201.4)	(1681.8)
	21, 31	Tobacco and Leather	(NA)	(-)	(-)	(-)	(-)	(-)

TABLE II-6G

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: G - KANAWHA-LITTLE KANAWHA

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	200.7	217.7	206.8	214.3	223.2	242.0
B.		Mining	243.9	329.4	428.5	536.0	663.3	807.3
	12	Coal Mining	159.8	212.6	271.1	331.1	383.5	431.3
	10, 13, 14	Other Mining	84.1	116.8	157.4	204.9	279.8	376.0
C.	15-17	Construction	299.2	534.6	787.4	1122.0	1639.0	2249.2
D.		Manufacturing	1502.6	2195.4	3159.4	4309.3	5959.0	8031.2
	24-25	Lumber and Furniture	115.7	155.1	206.0	269.9	363.2	480.7
	33	Primary Metals	77.1	98.6	121.0	146.0	180.3	218.9
	34	Fabricated Metals	28.3	20.6	28.0	37.0	50.3	68.4
	35-36	Machinery and Electrical Machinery	64.9	104.8	172.3	252.3	375.6	531.7
	37 except 371	Transportation Equipment	4.0	5.7	9.0	13.1	18.4	25.6
	371	Motor Vehicles	7.0	11.1	17.8	25.7	39.0	55.9
	19, 32, 38-39	Other Durables	85.8	106.0	139.7	179.0	239.1	314.6
	20	Food	140.6	172.8	234.9	316.6	433.3	585.9
	22	Textiles	73.5	110.2	158.3	213.8	300.3	409.3
	23	Apparel	50.0	88.3	140.1	209.6	304.6	431.2
	27	Printing	31.5	46.6	68.8	95.6	135.0	187.6
	28	Chemicals	769.3	1198.9	1757.5	2409.8	3328.8	4465.5
		Other Nondurables	54.9	76.7	106.0	140.9	191.1	255.9
	26	Paper	(NA)	(-)	(-)	(-)	(-)	(-)
	29	Petroleum Refining	(NA)	(19.9)	(27.6)	(36.6)	(49.7)	(66.5)
	30	Rubber and Plastics	(NA)	(14.6)	(20.1)	(26.8)	(36.3)	(48.6)
	21, 31	Tobacco and Leather	(NA)	(42.2)	(58.3)	(77.5)	(105.1)	(140.8)

TABLE II-6H

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: H - OHIO-HUNTINGTON

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	118.6	121.5	117.9	124.6	132.2	145.7
B.		Mining	69.9	114.3	169.8	237.2	330.8	453.9
	12	Coal Mining	11.4	20.5	34.3	54.8	81.8	119.2
	10, 13, 14	Other Mining	58.5	93.8	135.5	182.4	249.0	334.7
C.	15-17	Construction	213.8	325.7	475.2	673.2	980.3	1338.4
D.		Manufacturing	1175.7	1531.9	2172.4	2972.6	4141.8	5683.7
	24-25	Lumber and Furniture	33.7	53.5	76.8	107.0	151.9	209.8
	33	Primary Metals	421.0	372.0	421.6	486.8	585.9	714.2
	34	Fabricated Metals	19.2	11.5	14.3	19.4	27.0	36.7
	35-36	Machinery and Electrical Machinery	34.1	62.3	96.2	134.4	191.6	263.2
	37 except 371	Transportation Equipment	35.4	56.2	84.1	107.3	136.2	174.2
	371	Motor Vehicles	34.8	81.9	144.5	222.8	335.2	494.9
	19, 32, 38-39	Other Durables	87.0	112.4	147.8	188.3	250.7	328.9
	20	Food	111.8	136.8	188.7	254.9	349.2	475.6
	22	Textiles	2.0	3.2	4.8	6.5	9.3	12.8
	23	Apparel	16.4	23.4	29.0	35.6	43.9	53.4
	27	Printing	20.0	24.7	35.0	46.5	63.7	85.8
	28	Chemicals	187.8	323.3	549.9	845.9	1282.1	1857.2
		Other Nondurables	172.5	270.7	379.7	517.2	715.1	977.0
	26	Paper	(NA)	(-)	(-)	(-)	(-)	(-)
	29	Petroleum Refining	(NA)	(81.2)	(102.5)	(129.3)	(171.6)	(229.6)
	30	Rubber and Plastics	(NA)	(37.9)	(53.2)	(72.4)	(100.1)	(136.8)
	21, 31	Tobacco and Leather	(NA)	(151.6)	(224.0)	(315.5)	(443.4)	(610.6)

TABLE II-6I

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: I - SCIOTO

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	231.8	233.6	242.0	270.6	301.6	347.4
B.		Mining	32.3	44.9	60.6	79.1	108.5	146.3
	12	Coal Mining	.4	.8	1.4	2.3	3.6	5.4
	10, 13, 14	Other Mining	31.9	44.1	59.2	76.8	104.9	140.9
C.	15-17	Construction	497.2	709.2	1043.6	1483.6	2165.4	2967.5
D.		Manufacturing	2662.0	4170.7	6306.1	8869.0	12622.3	17540.1
	24-25	Lumber and Furniture	31.6	38.0	49.5	63.1	83.5	108.8
	33	Primary Metals	119.5	120.1	131.5	146.0	171.0	204.1
	34	Fabricated Metals	237.6	317.0	410.0	532.8	730.0	950.2
	35-36	Machinery and Electrical Machinery	614.4	1006.6	1643.0	2389.0	3507.2	4919.2
	37 except 371	Transportation Equipment	238.8	451.5	823.6	1232.5	1788.3	2585.9
	371	Motor Vehicles	152.0	325.4	530.2	773.8	1122.7	1603.0
	19, 32, 38-39	Other Durables	228.9	362.0	523.9	724.7	1034.6	1441.5
	20	Food	409.0	645.7	888.7	1201.7	1655.7	2250.6
	22	Textiles	14.4	19.5	26.8	34.9	47.8	63.6
	23	Apparel	13.5	11.7	11.5	10.7	8.4	4.7
	27	Printing	95.1	132.3	192.6	264.2	369.8	508.0
	28	Chemicals	145.5	220.0	347.7	507.5	739.9	1038.0
		Other Nondurables	361.7	520.9	727.1	988.1	1363.4	1862.5
	26	Paper	(NA)	(296.9)	(429.0)	(598.8)	(824.8)	(1131.5)
	29	Petroleum Refining	(NA)	(7.8)	(10.9)	(14.8)	(20.5)	(27.9)
	30	Rubber and Plastics	(NA)	(104.2)	(167.2)	(237.2)	(334.0)	(461.0)
	21,31	Tobacco and Leather	(NA)	(112.0)	(120.0)	(143.3)	(184.1)	(242.1)

TABLE II-6J

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: J - GUYANDOT-BIG SANDY-LITTLE SANDY

(In millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	40.1	43.6	29.0	17.2	5.1	1.9
B.		Mining	386.7	511.3	642.2	764.9	869.4	952.3
	12	Coal Mining	336.1	433.2	531.3	616.7	667.1	680.4
	10, 13, 14	Other Mining	50.6	78.1	110.9	148.2	202.3	271.9
C.	15-17	Construction	85.4	140.3	208.1	296.3	435.0	594.4
D.		Manufacturing	139.3	177.1	244.4	326.8	444.9	598.9
	24-25	Lumber and Furniture	28.3	27.3	25.3	20.0	11.9	2.7
	33	Primary Metals	7.7	12.9	16.4	22.4	29.5	39.0
	34	Fabricated Metals	2.0	3.8	5.9	8.8	12.3	16.7
	35-36	Machinery and Electrical Machinery	10.2	17.2	28.0	41.4	57.5	82.6
	37 except 371	Transportation Equipment	.9	.5	.4	.5	.7	.9
	371	Motor Vehicles	5.7	11.1	20.2	31.3	49.9	71.0
	19, 32, 38-39	Other Durables	18.7	18.6	23.2	28.4	36.0	44.3
	20	Food	34.5	32.5	40.3	49.1	62.5	78.3
	22	Textiles	-	-	-	-	-	-
	23	Apparel	5.6	9.6	15.4	23.5	34.7	49.4
	27	Printing	6.9	10.5	16.1	23.2	34.1	48.4
	28	Chemicals	9.8	18.0	29.6	42.6	63.6	89.9
		Other Nondurables	9.0	15.1	23.6	35.6	52.2	75.7
	26	Paper	(NA)	(-)	(-)	(-)	(-)	(-)
	29	Petroleum Refining	(NA)	(15.1)	(23.6)	(35.6)	(52.2)	(75.7)
	30	Rubber and Plastics	(NA)	(-)	(-)	(-)	(-)	(-)
	21,31	Tobacco and Leather	(NA)	(-)	(-)	(-)	(-)	(-)

TABLE II-6K

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: K - OHIO-CINCINNATI

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	166.4	175.0	179.2	198.6	219.7	251.8
B.		Mining	11.3	15.3	20.5	26.3	35.9	48.3
	12	Coal Mining	-	-	-	-	-	-
	10, 13, 14	Other Mining	11.3	15.3	20.5	26.3	35.9	48.3
C.	15-17	Construction	556.0	739.2	1018.8	1366.0	1897.5	2480.1
D.		Manufacturing	3718.9	5397.9	7483.9	9893.8	13392.3	17892.6
	24-25	Lumber and Furniture	78.1	100.9	132.6	171.8	229.7	301.6
	33	Primary Metals	121.4	82.5	49.3	22.4	15.5	16.7
	34	Fabricated Metals	290.6	438.8	620.5	864.5	1229.4	1703.6
	35-36	Machinery and Electrical Machinery	570.1	672.4	787.5	811.9	812.6	717.5
	37 except 371	Transportation Equipment	100.2	160.7	272.5	387.0	540.9	759.1
	371	Motor Vehicles	441.8	774.0	1263.0	1847.6	2680.5	3829.9
	19, 32, 38-39	Other Durables	192.7	373.9	585.3	857.6	1277.9	1842.0
	20	Food	719.6	1180.8	1636.2	2226.0	3082.9	4208.3
	22	Textiles	14.7	20.7	27.4	35.0	46.9	61.5
	23	Apparel	52.5	58.3	45.6	23.1	14.1	9.4
	27	Printing	166.2	208.8	272.6	333.3	431.9	546.0
	28	Chemicals	572.0	791.4	1114.2	1472.5	1965.5	2557.3
		Other Nondurables	399.0	534.7	677.2	841.1	1064.5	1339.7
	26	Paper	(NA)	(239.2)	(291.2)	(357.4)	(449.8)	(562.6)
	29	Petroleum Refining	(NA)	(43.5)	(47.4)	(54.7)	(66.5)	(80.4)
	30	Rubber and Plastics	(NA)	(157.7)	(223.5)	(294.4)	(383.2)	(495.7)
	21, 31	Tobacco and Leather	(NA)	(103.3)	(115.1)	(134.6)	(165.0)	(201.0)

TABLE II-6L

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: L - LITTLE MIAMI-MIAMI

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	301.7	304.5	319.4	360.8	405.7	470.4
B.		Mining	24.0	35.2	48.8	64.6	88.2	118.5
	12	Coal Mining	-	-	-	-	-	-
	10, 13, 14	Other Mining	24.0	35.2	48.8	64.6	88.2	118.5
C.	15-17	Construction	510.8	717.8	1038.9	1457.5	2105.5	2856.4
D.		Manufacturing	4451.1	6564.6	9052.7	11767.7	15641.7	20466.2
	24-25	Lumber and Furniture	47.4	57.3	74.3	95.0	125.7	162.6
	33	Primary Metals	369.0	465.3	536.7	624.9	761.5	935.0
	34	Fabricated Metals	280.5	414.9	578.8	799.3	1126.3	1550.3
	35-36	Machinery and Electrical Machinery	1523.3	2192.1	3021.6	3798.8	4902.4	6116.7
	37 except 371	Transportation Equipment	203.5	343.5	569.4	795.1	1096.8	1522.9
	371	Motor Vehicles	441.8	840.6	1070.1	1240.7	1439.2	1641.7
	19, 32, 38-39	Other Durables	137.7	231.5	364.5	535.6	799.8	1155.5
	20	Food	414.8	535.1	730.9	984.8	1351.7	1830.1
	22	Textiles	23.7	26.5	35.4	45.2	60.7	79.8
	23	Apparel	15.7	13.1	9.7	3.6	2.5	1.7
	27	Printing	178.6	247.8	352.1	473.4	651.0	881.7
	28	Chemicals	151.3	197.7	281.2	377.2	510.4	668.5
		Other Nondurables	663.8	999.2	1428.0	1994.1	2813.7	3919.7
	26	Paper	(NA)	(582.3)	(832.3)	(1162.3)	(1639.8)	(2284.3)
	29	Petroleum Refining	(NA)	(13.7)	(19.4)	(27.3)	(38.5)	(53.7)
	30	Rubber and Plastics	(NA)	(390.3)	(557.9)	(779.1)	(1099.1)	(1531.1)
	21,31	Tobacco and Leather	(NA)	(12.9)	(18.4)	(25.7)	(36.3)	(50.6)

TABLE II-6M

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: M - LICKING-KENTUCKY-SALT

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	500.2	534.9	546.7	604.3	667.2	763.1
B.		Mining	101.8	144.1	190.9	239.9	295.7	358.9
	12	Coal Mining	63.7	82.9	102.8	121.3	133.8	141.3
	10, 13, 14	Other Mining	38.1	61.2	88.1	118.6	161.9	217.6
C.	15-17	Construction	307.8	492.8	740.8	1069.7	1588.6	2202.1
D.		Manufacturing	739.2	1161.2	1837.0	2707.5	3993.8	5861.6
	24-25	Lumber and Furniture	37.0	68.0	99.9	142.2	205.6	287.3
	33	Primary Metals	11.6	16.1	22.3	30.3	42.0	51.9
	34	Fabricated Metals	27.6	43.6	71.0	110.3	168.1	248.4
	35-36	Machinery and Electrical Machinery	167.3	291.8	535.0	839.3	1303.2	2064.7
	37 except 371	Transportation Equipment	9.3	13.9	22.1	29.2	38.8	52.1
	371	Motor Vehicles	25.8	44.9	81.5	126.5	191.8	290.5
	19, 32, 38-39	Other Durables	44.4	67.6	107.8	160.6	241.2	351.8
	20	Food	250.5	329.0	453.3	615.9	849.4	1157.2
	22	Textiles	1.4	3.0	3.7	4.4	5.5	6.9
	23	Apparel	53.4	91.8	139.7	203.2	289.7	403.7
	27	Printing	23.6	33.1	48.6	67.5	94.7	131.5
	28	Chemicals	11.4	24.6	40.4	61.4	93.6	133.7
		Other Nondurables	75.9	133.8	211.7	316.7	470.2	681.9
	26	Paper	(NA)	(6.7)	(10.6)	(15.9)	(23.6)	(34.2)
	29	Petroleum Refining	(NA)	(-)	(-)	(-)	(-)	(-)
	30	Rubber and Plastics	(NA)	(45.4)	(71.9)	(107.5)	(159.6)	(231.4)
	21, 31	Tobacco and Leather	(NA)	(81.7)	(129.2)	(193.3)	(287.0)	(416.3)

TABLE II-6N

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: N - OHIO-LOUISVILLE

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	127.6	134.2	137.4	151.7	168.2	191.9
B.		Mining	22.2	34.5	49.0	65.7	89.7	120.5
	12	Coal Mining	-	-	-	-	-	-
	10, 13, 14	Other Mining	22.2	34.5	49.0	65.7	89.7	120.5
C.	15-17	Construction	354.4	544.2	793.6	1122.0	1632.7	2227.8
D.		Manufacturing	2201.7	3466.8	5150.9	7222.7	10340.4	14437.9
	24-25	Lumber and Furniture	89.7	129.2	172.4	227.4	307.5	480.1
	33	Primary Metals	32.7	42.9	41.1	39.5	42.0	44.5
	34	Fabricated Metals	211.0	279.6	360.5	467.6	628.2	826.8
	35-36	Machinery and Electrical Machinery	378.0	683.0	1174.2	1771.8	2675.4	3835.2
	37 except 371	Transportation Equipment	17.0	9.0	10.8	9.6	6.8	4.7
	371	Motor Vehicles	119.8	170.6	241.3	311.3	407.0	529.3
	19, 32, 38-39	Other Durables	68.5	115.7	174.4	248.2	362.9	514.8
	20	Food	550.3	843.1	1167.6	1588.0	2199.0	3001.8
	22	Textiles	7.1	7.9	7.6	6.7	5.6	3.5
	23	Apparel	26.8	29.8	30.5	29.1	25.5	18.1
	27	Printing	82.7	118.0	168.6	228.0	314.8	428.4
	28	Chemicals	320.3	564.3	921.9	1378.5	2043.2	2917.0
		Other Nondurables	297.8	473.7	680.0	917.0	1322.5	1833.7
	26	Paper	(NA)	(90.0)	(149.6)	(219.6)	(330.6)	(467.6)
	29	Petroleum Refining	(NA)	(9.7)	(13.9)	(18.8)	(27.1)	(37.6)
	30	Rubber and Plastics	(NA)	(10.4)	(18.4)	(29.3)	(48.9)	(77.0)
	21, 31	Tobacco and Leather	(NA)	(363.6)	(498.1)	(649.3)	(915.9)	(1251.5)

TABLE II-60

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: O - LOWER OHIO-EVANSVILLE

(In millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	208.4	224.3	225.8	246.6	269.5	305.9
B.		Mining	184.6	316.2	487.7	705.3	1004.1	1403.0
	12	Coal Mining	61.5	111.7	188.9	300.9	451.9	661.0
	10, 13, 14	Other Mining	123.1	204.5	298.8	404.4	552.2	742.0
C.	15-17	Construction	238.9	381.4	563.7	806.1	1182.0	1624.9
D.		Manufacturing	1115.1	1603.6	2255.3	3011.8	4101.8	5477.7
	24-25	Lumber and Furniture	73.7	97.8	129.9	170.3	229.7	303.8
	33	Primary Metals	27.9	38.6	50.5	64.5	85.5	111.3
	34	Fabricated Metals	74.8	161.6	271.2	419.9	641.7	940.2
	35-36	Machinery and Electrical Machinery	277.3	400.5	484.9	523.9	559.6	552.3
	37 except 371	Transportation Equipment	24.2	33.5	49.0	62.0	77.7	100.3
	371	Motor Vehicles	38.2	13.2	16.1	15.7	15.6	10.8
	19, 32, 38-39	Other Durables	35.0	44.8	61.4	81.5	113.2	153.0
	20	Food	252.4	338.6	439.0	563.6	741.6	965.8
	22	Textiles	17.4	24.2	33.4	43.9	60.4	80.9
	23	Apparel	21.1	22.3	24.4	25.6	26.5	25.5
	27	Printing	26.6	35.7	50.3	66.4	90.7	121.1
	28	Chemicals	143.1	247.0	441.2	699.3	1080.8	1596.4
		Other Nondurables	103.4	145.8	204.0	275.2	378.8	516.3
	26	Paper	(NA)	(10.9)	(9.2)	(8.3)	(7.6)	(7.7)
	29	Petroleum Refining	(NA)	(4.4)	(4.1)	(4.1)	(4.7)	(5.2)
	30	Rubber and Plastics	(NA)	(91.1)	(145.8)	(210.5)	(302.1)	(420.8)
	21, 31	Tobacco and Leather	(NA)	(39.4)	(44.9)	(52.3)	(64.4)	(82.6)

TABLE II-6P

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: P - GREEN

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	323.4	348.6	358.9	398.8	442.3	508.1
B.		Mining	141.3	197.6	262.8	333.4	411.8	499.6
	12	Coal Mining	111.2	149.5	193.5	240.3	284.6	328.8
	10, 13, 14	Other Mining	30.1	48.1	69.3	93.1	127.1	170.8
C.	15-17	Construction	148.5	247.5	382.0	562.1	844.7	1184.4
D.		Manufacturing	305.9	450.6	710.5	1046.8	1538.5	2183.7
	24-25	Lumber and Furniture	31.5	47.9	69.4	97.4	139.2	193.4
	33	Primary Metals	9.6	17.2	25.8	34.2	46.6	59.4
	34	Fabricated Metals	4.7	8.6	13.7	21.2	33.1	48.3
	35-36	Machinery and Electrical Machinery	47.8	82.2	148.3	233.1	360.3	526.5
	37 except 371	Transportation Equipment	.6	1.4	3.0	4.0	6.1	8.5
	371	Motor Vehicles	14.7	25.9	47.6	76.1	116.9	174.3
	19, 32, 38-39	Other Durables	9.4	14.4	22.0	32.3	47.6	68.6
	20	Food	89.5	83.3	115.1	156.7	217.7	298.7
	22	Textiles	4.5	6.2	9.4	13.3	19.3	26.8
	23	Apparel	53.9	90.8	143.7	214.6	311.8	441.0
	27	Printing	8.0	18.2	26.8	36.9	52.0	72.0
	28	Chemicals	9.8	16.8	28.8	43.9	67.1	94.8
		Other Nondurables	21.9	37.7	56.9	83.1	120.8	171.4
	26	Paper	(NA)	(13.6)	(20.5)	(29.9)	(43.5)	(61.7)
	29	Petroleum Refining	(NA)	(--)	(--)	(--)	(--)	(--)
	30	Rubber and Plastics	(NA)	(--)	(--)	(--)	(--)	(--)
	21,31	Tobacco and Leather	(NA)	(24.1)	(36.4)	(53.2)	(77.3)	(109.7)

TABLE II-6Q

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: Q - WHITE

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	380.7	391.8	398.4	437.9	481.8	549.1
B.		Mining	115.1	187.2	284.6	438.2	630.6	889.3
	12	Coal Mining	22.8	49.1	91.6	155.4	244.5	370.4
	10, 13, 14	Other Mining	92.3	138.1	193.0	282.8	386.1	518.9
C.	15-17	Construction	702.3	1032.7	1500.2	2108.9	3051.1	4147.7
D.		Manufacturing	5473.1	8326.2	12255.0	16799.6	23407.6	31949.2
	24-25	Lumber and Furniture	149.6	206.8	282.2	378.6	521.3	700.9
	33	Primary Metals	257.2	293.7	332.4	382.8	464.7	564.0
	34	Fabricated Metals	329.3	429.7	548.2	704.9	938.6	1228.5
	35-36	Machinery and Electrical Machinery	1375.7	2322.1	3708.9	5304.6	7692.9	10690.0
	37 except 371	Transportation Equipment	375.5	687.8	1153.0	1626.6	2259.1	3156.6
	371	Motor Vehicles	966.0	1431.2	2063.6	2723.3	3628.5	4808.9
	19, 32, 38-39	Other Durables	267.0	349.4	475.2	625.5	855.8	1149.8
	20	Food	786.1	1097.5	1472.5	1950.5	2640.9	3532.6
	22	Textiles	6.8	3.1	2.0	1.3	.8	.5
	23	Apparel	39.0	32.8	22.5	5.1	2.5	1.7
	27	Printing	146.7	199.6	283.3	380.8	523.6	708.7
	28	Chemicals	379.9	643.6	1012.6	1471.2	2135.1	2992.4
		Other Nondurables	394.3	628.9	898.6	1244.4	1743.8	2414.6
	26	Paper	(NA)	(283.0)	(395.4)	(541.3)	(749.8)	(1026.2)
	29	Petroleum Refining	(NA)	(21.2)	(30.3)	(41.9)	(58.8)	(81.4)
	30	Rubber and Plastics	(NA)	(248.1)	(363.5)	(509.6)	(722.8)	(1012.9)
	21, 31	Tobacco and Leather	(NA)	(76.6)	(109.4)	(151.6)	(212.4)	(294.1)

TABLE II-6R

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: R - WABASH

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	Agriculture, Forestry, and Fisheries	633.3	643.7	670.3	751.8	841.2	972.6
B.		Mining	163.1	321.1	563.7	914.2	1428.3	2148.9
	12	Coal Mining	24.2	116.6	279.7	539.2	916.2	1460.7
	10, 13, 14	Other Mining	138.9	204.5	284.0	375.0	512.1	688.2
C.	15-17	Construction	491.4	794.9	1157.0	1625.3	2360.8	3211.3
D.		Manufacturing	3178.0	4601.6	6742.9	9351.5	13174.7	18166.7
	24-25	Lumber and Furniture	79.6	114.1	156.8	211.3	292.4	394.9
	33	Primary Metals	440.3	543.6	649.4	778.8	969.8	1213.2
	34	Fabricated Metals	172.9	214.9	263.3	326.4	418.4	530.1
	35-36	Machinery and Electrical Machinery	598.2	1006.6	1673.1	2468.5	3660.5	5182.4
	37 except 371	Transportation Equipment	44.1	45.8	75.5	105.3	145.1	200.7
	371	Motor Vehicles	399.3	666.2	1079.8	1568.8	2267.2	3227.5
	19, 32, 38-39	Other Durables	187.2	236.6	328.6	439.6	610.4	832.3
	20	Food	493.4	571.1	722.6	908.8	1172.8	1499.5
	22	Textiles	2.2	3.4	3.9	4.3	5.1	6.0
	23	Apparel	52.1	56.2	56.2	52.4	42.9	26.2
	27	Printing	131.3	202.1	307.6	436.9	628.6	884.5
	28	Chemicals	182.7	328.1	557.1	855.9	1296.2	1879.0
		Other Nondurables	394.7	612.9	869.0	1194.5	1665.3	2290.4
	26	Paper	(NA)	(168.5)	(238.9)	(328.4)	(457.8)	(630.7)
	29	Petroleum Refining	(NA)	(65.5)	(92.9)	(127.7)	(178.0)	(245.3)
	30	Rubber and Plastics	(NA)	(231.8)	(333.0)	(463.7)	(654.8)	(913.6)
	21, 31	Tobacco and Leather	(NA)	(147.1)	(204.2)	(274.7)	(374.7)	(500.8)

TABLE II-6S

OUTPUT BY INDUSTRY, 1960-2010

SUBAREA: S - CUMBERLAND

(in millions of 1960 dollars)

	SIC	Industry	1960	1970	1980	1990	2000	2010
A.	01-09	*Agriculture, Forestry, and Fisheries*	567.4	605.7	611.3	667.9	730.7	828.2
B.		Mining	70.1	96.7	125.5	154.2	184.8	216.4
	12	Coal Mining	47.4	60.6	73.6	84.5	89.6	88.4
	10, 13, 14	Other Mining	22.7	36.1	51.9	69.7	95.2	128.0
C.	15-17	Construction	543.8	857.0	1292.0	1869.3	2780.1	3857.0
D.		Manufacturing	1690.3	2556.0	3755.9	5244.2	7395.9	10410.0
	24-25	Lumber and Furniture	135.7	199.4	277.7	378.9	528.7	720.2
	33	Primary Metals	14.4	10.7	11.7	13.2	14.0	16.7
	34	Fabricated Metals	97.4	167.4	254.9	373.2	548.4	783.5
	35-36	Machinery and Electrical Machinery	140.0	236.1	418.8	644.6	988.9	1435.0
	37 except 371	Transportation Equipment	42.8	76.5	139.5	209.1	303.2	438.2
	371	Motor Vehicles	38.2	68.7	117.8	180.3	269.8	393.8
	19, 32, 38-39	Other Durables	96.9	141.9	227.7	338.9	511.0	743.7
	20	Food	354.1	534.3	761.8	1060.8	1496.2	2073.7
	22	*Textiles*	44.2	58.6	77.9	99.2	132.9	174.4
	23	Apparel	164.3	245.0	374.9	547.9	782.7	1093.1
	27	Printing	93.0	135.4	202.2	283.4	402.9	562.0
	28	Chemicals	183.1	213.3	204.0	147.9	42.4	48.6
		Other Nondurables	286.2	468.7	687.0	966.8	1374.8	1927.1
	26	Paper	(NA)	(39.4)	(57.8)	(81.3)	(115.6)	(162.1)
	29	Petroleum Refining	(NA)	(11.7)	(18.9)	(29.0)	(44.7)	(67.4)
	30	Rubber and Plastics	(NA)	(47.8)	(70.8)	(100.6)	(144.4)	(204.3)
	21,31	Tobacco and Leather	(NA)	(369.8)	(539.5)	(755.9)	(1070.1)	(1493.3)

CHAPTER III

METHODOLOGICAL FRAMEWORK

INTRODUCTION

The methodological framework used in this study consists of two distinct parts: first, the econometric forecasting model which is used to derive economic activity projections (for output and employment) in the Ohio River Basin as a whole, and, second, the allocation procedure used to distribute projected output and employment estimates among the 19 subareas into which the Basin has been divided.

It is logical to ask why the methods used for projecting economic activity at the regional level should differ from those used for the subarea projections. The determining reason for this difference lies in the availability of data over an adequate period of time and in a sufficiently detailed geographical and industry breakdown to make the projection method operational. In addition, it is possible to argue against the use of regional econometric models for deriving subarea projections on theoretical grounds, the principal argument being the relative "openness" of such smaller geographical areas as tributary river basins or sections of the Ohio River valley proper. The term "openness" describes the tendency of small areas to be more dependent upon economic activity outside of the area, by means of trade linkages, than upon interindustry relationships within the area. Further light will be thrown on this argument as the description of our methodology unfolds.

A. SELECTION OF PROJECTION MODEL

The selection of a forecasting framework is essentially an evolutionary process. In the Ohio River Basin study a choice had to be made between the more conventional projection approaches such as trend extrapolations, share analysis of gross product originating by industry and areas, or alternative versions of the "base theory," and the newer, presumably more sophisticated methods of analysis which explicitly point up the interrelations between the various components of an economic system or of a regional economy.

All analytical projection methods are characterized by certain advantages and disadvantages in terms of the quality of the end product. In fact, a consensus as to which method possesses the better predictive qualities has never been reached. We therefore based our choice of methodology upon a number of criteria, described below, which we felt would enhance the usefulness of our work to the Corps' continuing program of river basin studies.

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Our criteria required a method with the following attributes:

1. It should seek to provide a projection framework pointing up the growth relationships between various industry sectors and the final demand sectors, as represented by intermediate demand, household or consumer demand, demand for investment goods, demand by government and demand originating outside of the region for goods produced within the region.

2. It ought to be explicit about the degree of consistency achieved in our projections.

3. It should strive to develop a framework capable of incorporating special information in the form of general assumptions regarding patterns of national growth; independent statistical analyses of growth in certain key "export" industries; the empirical judgment of industry specialists; and the reconciliation of a variety of scanty data obtained from different sources.

4. It should offer a framework suitable for use as a planning tool, which would permit periodic review and revision of the projections and would provide a means for incorporating new assumptions in the event that revisions are required.

5. Finally, it should aim to use a framework corresponding in theory as well as in form to models that are being used with increasing frequency in making judgments about the future growth of regions or metropolitan areas. Furthermore, the framework should have methodological ties to those being adopted by other government agencies in the preparation of national and regional economic projections. In this connection the following quotation from a U. S. Department of Labor report*, which anticipates the central role that the interindustry relations table will play in providing future projections of national economic activity, is illuminating:

> "The Department of Labor, in cooperation with other Government agencies and private research organizations, has undertaken an extensive program of economic growth studies aimed at providing a more comprehensive and integrated framework than has previously been available for analyzing the problems of long-run economic growth in relation to employment opportunities...

*Manpower Report of the President, U. S. Department of Labor, March 1963, p. 129.

> A primary objective of the program is to develop projections, under alternative assumptions, of the rate and patterns of growth in the economy. These would then provide a framework for assessing a number of important economic problems, including problems of manpower utilization over the next decade. The projections will cover both the supply of and demand for labor in considerable industry detail ...
>
> The elements in the integrated set of projections indicated above will be developed by various units of the Department of Labor and other Government agencies and private research organizations. In particular, the Office of Business Economics of the Department of Commerce is preparing the interindustry data which play a central role in the projections... "

We believe that the model developed for this study meets the objectives spelled out above more adequately than any framework we know. There is, of course, room for improvements. It should be emphasized, however, that data limitations, more than any other factor, constituted the main roadblock to realizing the full potential of our model. For in an econometric model the data contribute the facts that are needed to make the model work. Insofar as these facts are not obtainable, some of the model's strength is inevitably lost. Moreover, the full impact of data limitations usually cannot be determined in studies of this type until specific data are required at various stages of constructing an operational model.

A case example from our own experience illustrates the problem. Our first model framework was conceived with the understanding that the 1958 national interindustry (input-output) table would become available for use in this study. When it became apparent that the publication of that table would be delayed beyond the time period available for the Ohio River Basin study, we were forced to revise our original model framework. Even with the revision, implementation of the model proved to be a formidable task. As it is now formulated, the model relies chiefly on readily available secondary data sources, such as census reports and published government surveys.

B. STRUCTURE OF THE REGIONAL MODEL FOR THE OHIO RIVER BASIN

The purpose of the model for the Ohio River Basin study is to project levels of industrial (manufacturing and non-manufacturing) activity, government activity, income and employment in the Basin to the years 1980 and 2010.

In our model we view the future level and structure of employment and output in the Ohio River Basin as the outcome of an interplay between the supply of labor and the demand for labor. The future labor supply is projected on the basis of Ohio River Basin population trends, including such vital characteristics as (1) age and sex distribution; (2) age-specific birth and death rates; (3) migration rates; and (4) age-specific labor-participation rates for men and women. The future demand for labor is projected on the basis of forecasts regarding the levels and structure of industrial and government activities, and forecasts regarding income and productivity trends.

Consistency in the model is achieved by a number of measures or checks. First, we can determine how well the estimated growth in the value of output for certain key industries (chiefly, the export industries) compares with ranges of projections made for these industries through independent regression analyses. Next, we can check how well the estimated future supply of labor in the Ohio River Basin matches the future demand for labor. If the difference between the projected demand for and the projected supply of labor for a given year is considerable, say, more than 10% (taking into consideration a certain level of unemployment), we reject our projection and start over again by revising one or more of our basic assumptions, such as the rate of outmigration or the level of exports and imports. Finally, when the difference between projected demand and supply for all projection years is relatively small, i.e. less than 10%, and when the growth in value of output in the model seems to approximate the range of independent key industry projections, consistency is achieved by reconciling the demand for and the supply of labor. This reconciliation consists of finding the average between the demographic projection and the model projection of the labor force for each year; that figure is then accepted as the "equilibrium" or final labor force estimate. The regional population projection is then derived from this "equilibrium" labor force estimate.

1. Population and the Supply of Labor

We begin by stating four definitional relationships. The first defines the total population in the base year, 1960, as the sum of the number of males and females (P_F^{60}):

$$(1) \qquad P^{60} = P_M^{60} + P_F^{60}$$

The second relation defines the total male population as the sum of the number of males in different age groups. The third relation, similarly, defines the total female population as the sum of the number of females in different age groups:

(2) $$P_M^{60} = \sum_a P_{aM}^{60}$$

(3) $$P_F^{60} = \sum_a P_{aF}^{60}$$

The components in these three relations form a basis for projecting the total population in 1970, which by definition is equal to the population in 1960 plus the number of births (P_B), minus the number of deaths (P_D), plus net migration (P_N):

(4) $$P^{70} = P^{60} + P_B - P_D + P_N$$

where

(5) P_B = function of the number of women in childbearing age groups and of age-specific birth rates for these childbearing age groups.

(6) P_D = function of the number of males and females in different age groups and of age- and sex-specific death rates.

(7) P_N = size of net migration. As a preliminary, this variable is estimated for future years by extrapolating past trends. As mentioned above, these preliminary estimates can be revised, as needed.

Next we again write the relations (1) - (3) above, for the projected years, in order to form a basis for estimating the size of the labor force, which is calculated by applying age-specific labor-participation rates.

Denoting the labor force by L_S, we have, say, for the year 1970:

(8) $$L_S^{70} = \sum_a \lambda_{aM} P_{aM}^{70} + \sum_a \lambda_{aF} P_{aF}^{70}$$

where λ_{aM} = labor participation rate among men in age group $\underline{a}$

λ_{aF} = labor participation rate among women in age group $\underline{a}$

P_{aM}^{70} = number of men in age group $\underline{a}$, in 1970

P_{aF}^{70} = number of women in age group $\underline{a}$, in 1970

2. Demand for Labor in the Ohio River Basin

Industrial activity in the Ohio River Basin--ranging from agriculture to the service industries--has been classified into 27 major industry groups. In addition to these industry groups, we have a government sector and a sector for "nonclassified" activities,* for a total of 29 employment sectors (See Table III-1 for the sector designations and their corresponding Standard Industrial Classification Code). Sectors 1 through 27 are determined by solving a set of simultaneous linear equations, while sectors 28 and 29 (Government and Nonclassified) are related to the results obtained from solving these equations. Hence, sectors 28 and 29 are treated separately in this discussion.

We shall denote the amount of labor demanded by each of the 27 model sectors by the symbol L, with a subscript number to denote the appropriate sector in which the demand arises.

Thus,

L_i^{70} = the amount of labor demanded in 1970 by sector number i ($i = 1, \ldots\ldots\ldots\ldots, 27$, excluding government and nonclassified)

We define the total demand for labor in the Ohio River Basin as the sum of the labor demanded by the 27 industrial sectors plus the labor demanded by non-defense government activities (federal, state and local) plus the labor demanded by defense government agencies (including the armed forces). Using L_D to denote the total Ohio River Basin demand for labor, we have the following definitional relation, say, for 1970:

$$(9) \qquad L_D^{70} = \sum_i L_i^{70} + L_{G_1}^{70} + L_{G_2}^{70}$$

where $\sum_i L_i^{70}$ = Number of workers demanded in 27 industry sectors

$L_{G_1}^{70}$ = Number of non-defense government workers demanded in 1970

$L_{G_2}^{70}$ = Number of defense government workers (including personnel in the armed forces), demanded in 1970

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*The "nonclassified" sector represents an employment category which the Census of Population designates as consisting of respondents who have not listed the industry in which they are employed. Since our model uses Census of Population figures as control totals, projection estimates for this category of employment are made on the basis of the model employment estimates in order to obtain total employment estimates.

Thus, the problem before us is how to derive the individual elements making up the right-hand side of (9), for any given year. We shall attack this problem in two steps. First, we shall discuss a way of projecting increases in productivity in terms of changes over time in Gross Product Originating per worker in each of the 27 industries, and changes over time in the average payroll per government employee. Second, we shall give a procedure for projecting the future levels of activity (gross output) in each of the 27 industries and the future levels of non-defense government activity. Then, we shall relate these steps to each other and to certain exogenous factors, giving us the future demand for labor in the Ohio River Basin.

a. Gross Product Originating

Due to lack of time-series data for the Ohio River Basin regarding changes in the Gross Product Originating (GPO)* in different industries per gainfully employed person, we assume that national trends apply. From what we know about the composition of Ohio River Basin industry, this is a very plausible assumption.

For each postwar year for which U. S. data regarding GPO (or Income Originating) are available,** we form a ratio for each of the 28 industries between its GPO and employment, to give us annual GPO per worker. Using 1960 as the base year, we form ratios, as follows:

$$\frac{\bar{Y}_i^{t+60}}{\bar{Y}_i^{60}} \qquad (i = 1, 2, \ldots\ldots, 28 \text{ -- including government})$$

where

$\bar{Y}_i^t$ = GPO per worker in industry i, in year t

$\bar{Y}_i^{60}$ = GPO per worker in industry i, in year 1960

t = Time counted from 1960 = 0, with years prior to 1960 being negative.

*Gross Product Originating (GPO) represents the gross product contribution of each industry to the total gross product of the region. The sum of gross product originating in each industry at the national level represents the gross national product. GPO can be measured as the amount by which an industry's total product exceeds the value of the materials and services it buys on current account from other industries, and thus directly gauges an industry's specific product contribution.

**U. S. data on GPO for the postwar period are available only for broad industrial sectors, such as nondurable and durable goods and 1-digit non-manufacturing sectors. In most cases, therefore, Value Added was used as a proxy measure of GPO, the two being very similar. For detail, see Chapter IV and Appendix E.

TABLE III-1

OHIO RIVER BASIN MODEL SECTOR BREAKDOWN
REFERENCE TABLE

Ohio River Basin Sector No.	SIC	Industry Title
1	A (01-09)	Agriculture, Forestry, & Fisheries
2	B (11, 12)	Coal Mining
3	B (10, 13, 14)	Other Mining (metals, crude oil, minerals)
4	C (15, 16, 17)	Construction
5	D (20)	Food & Kindred Products
6	D (22)	Textile Mill Products
7	D (23)	Apparel & Finished Products
8	D (24, 25)	Lumber and Wood Products, Furniture and Fixtures
9	D (26)	Paper and Allied Products
10	D (27)	Printing, Publishing, & Allied Products
11	D (28)	Chemicals and Allied Products
12	D (29)	Petroleum Refining
13	D (30)	Rubber and Miscellaneous Plastics
14	D (32)	Stone, Clay and Glass Products
15	D (331, 332, 339)	Ferrous Metals
16	D (333, 334, 335, 336)	Non-ferrous Metals
17	D (34)	Fabricated Metal Products
18	D (35)	Machinery, except Electrical
19	D (36)	Electrical Machinery
20	D (37, excl. 371)	Transportation Equipment
21	D (371)	Motor Vehicles
22	D (21, 31)	Tobacco and Leather Products
23	D (19, 38, 39)	Ordnance, Instruments & Miscellaneous Mfg.
24	E (40-49)	Transportation, Communications & Utilities
25	F (50-59)	Trade (wholesale and retail)
26	G (60-67)	Finance, Insurance & Real Estate
27	H (70-89)	Services
28	I (91-94)	Government
29	J (99)	Nonclassified establishments

We then summarize the data regarding the GPO per worker in all industries in terms of 28 equations. Our working hypothesis is that these data will expose regularities of the following compound-interest type:

$$(10) \qquad \frac{\bar{Y}_i^{\,t+60}}{\bar{Y}_i^{\,60}} = c_i (1 + r_i)^t$$

where

r_i = annual rate of growth

c_i = adjustment factor

In order to simplify the statistical work, we transform (10) into logarithms:

$$(11) \qquad \log \frac{\bar{Y}_i^{\,t+60}}{\bar{Y}_i^{\,60}} = \log c_i + t \log (1 + r_i) \qquad (\text{for } i = 1, 2, \ldots, 28)$$

We use simple least-squares regression* and solve for c_i and r_i by means of known values for the ratios on the left-hand side and for t.**

We then assume that the same growth rates (as found in equation (11)) will apply also to future years. Thus, for the year 1970 we have:

$$(12) \qquad \left(\frac{\bar{Y}_i^{\,70}}{\bar{Y}_i^{\,60}} \right) = c_i (1 + r_i)^{10}$$

where c_i and r_i are known constants, as found in the regression analyses (11) above.

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*A regression equation is a mathematical expression of the statistical relationship between one data series representing the dependent variable (i.e., the variable for which values are to be estimated) and one or more data series representing the independent variable (i.e., the variable for which values are given). In this study, the regression equations are derived by means of the so-called least-squares method, in which a graphic line representing the equation is fitted to data points so that the sum of the squared deviations of all the data points from the line is minimized. This provides a perfect fit when the sum of the squared deviations is zero. The equation makes it possible to derive value estimates for the dependent variable with given values for the independent variable(s).

**For exceptions to this procedure, see Chapter IV.

Assuming that the GPO in industry i (i = 1, 2, ..., 28) is a fixed proportion of its output, we have

$$(13) \qquad \frac{\bar{Y}_i^{70}}{\bar{Y}_i^{60}} = \frac{\bar{X}_i^{70}}{\bar{X}_i^{60}} \qquad (i = 1, 2, \ldots\ldots, 28)$$

where

$\bar{X}_i^{70}$ = output per worker in industry i, in 1970

$\bar{X}_i^{60}$ = output per worker in industry i, in 1960

From (12) and (13), we get:

$$(14) \qquad \bar{X}_i^{70} = \bar{X}_i^{60} \, c_i(1 + r_i)^{10}$$

In turn, by definition:

$$(15) \qquad \bar{X}_i^{70} = \frac{X_i^{70}}{L_i^{70}} \qquad (i = 1, 2, \ldots\ldots, 28)$$

where

X_i^{70} = Output (level of activity) of industry i, in 1970

L_i^{70} = (as before) Number of workers needed by industry i, in 1970

Finally, from (14) and (15):

$$(16) \qquad L_i^{70} = \frac{X_i^{70}}{\bar{X}_i^{60} \, c_i \, (1 + r_i)^{10}}$$

Since $\bar{X}_i^{60}$ (the base year value), c_i and r_i are known, we can derive the number of laborers in industry i, in 1970, from expression (16), once we know the level of activity in industry i, in 1970 (X_i^{70}). We shall now turn to the problem of determining these activity levels.

b. Output (Level of Activity) of Industry

We start with a definitional relationship which says that total output from any industry i, in a given year, is equal to the total usage of that same output, plus or minus any inventory changes.

$$(17) \qquad X_i^{70} = X_{iN}^{70} + C_i^{70} + I_i^{70} + E_i^{70} + G_{1i}^{70} + G_{2i}^{70} \quad (i = 1, 2, \ldots\ldots, 27)$$

where X_i^{70} = Total output of Ohio River Basin industry i, in 1970 (i = 1, 2, . . ., 27)

X_{iN}^{70} = Total usage among Ohio River Basin industries of intermediate products from the i^{th} industry (independent of whether they are produced by the i^{th} Ohio River Basin industry or elsewhere)

C_i^{70} = Ohio River Basin household consumption of products from the i^{th} industry (independent of whether they are produced in the Ohio River Basin or elsewhere)

I_i^{70} = Capital formation (including inventory changes) in the Ohio River Basin of products from the i^{th} industry (independent of whether they are produced in the Ohio River Basin or elsewhere)

E_i^{70} = Ohio River Basin net trade in products from the i^{th} industry (that is, exports to the rest of the U. S. and abroad of products from Ohio River Basin industry i minus total imports into the Ohio River Basin of the same products)

G_{1i}^{70} = Federal, state, and local government usage in the Ohio River Basin, for non-defense purposes, of products from the i^{th} industry (independent of whether they are produced in the Ohio River Basin or elsewhere)

G_{2i}^{70} = Federal, state, and local government usage in the Ohio River Basin, for defense purposes, of products from the i^{th} industry (independent of whether they are produced in the Ohio River Basin or elsewhere).

Thus, instead of attempting to project directly the levels of activity of each of the 27 industries in future years, we formulate the problem as one of projecting the six components specified on the right-hand side of expression (17). As we shall see, some of these can be meaningfully and explicitly related to the activity levels, whereas others will be projected exogenously.

c. Interindustry Flows

The first term on the right-hand side of equation (17) is referred to as "interindustry demand," "intermediate demand or usage," or some similar expression. This term and the way it is usually treated in empirically oriented economic analysis can best be characterized by the words interindustry or input-output analysis. The standard input-output framework estimates the usage by industry j of products from industry i as follows:

$$x_{ij} = a_{ij}X_j \qquad (i, j = 1, 2, \ldots\ldots\ldots\ldots 27) \tag{18}$$

where

x_{ij} = the usage by industry j of products from industry i (or the flow of products from industry i which is absorbed by industry j)

a_{ij} = proportionality coefficient, which states the amount of products absorbed by industry j from industry i per unit of its output.

X_j = level of output (activity) of industry j

A dominant portion of the work involved in standard input-output analysis is concerned with the empirical estimation of "a_{ij}" coefficients. Each of these linkage coefficients between all possible pairs of industrial sectors has to be estimated. True, many of these coefficients will for technical reasons have zero value. For instance, there is no direct flow, or linkage, between the steel industry and, say, the printing and publishing industry. However, in most cases the answer is not so obvious, and a great deal of work is often necessary for the estimation of a single linkage coefficient. Moreover, for projections over long periods of time, changes in these coefficients should be estimated on the basis of changes in technology, relative prices, and product mix, which are difficult to predict.

Consider the present study, where 27 industries are specified. We find that the number of interindustry coefficients is no less than 729. Considering the magnitude of the task involved in forecasting how they will change over time, it is not surprising that most input-output studies are capable of estimating these linkage coefficients for one point in time only. However, this limits the value of the analysis because we know that results will differ whenever the "a_{ij}" coefficients vary with output levels (implying economies or diseconomies of scale, per industry) or with time (implying technical changes and/or substitutions between inputs and outputs).

In view of these empirical difficulties and theoretical limitations, we have developed a new procedure for the Ohio River Basin study, which is helpful in overcoming some of the difficulties and limitations for projection purposes. We shall now describe our procedure in some detail.

New Procedure for Implementing Interindustry Flows. For any given industry, we form a sub-total which states the value of all intermediate-product type (non-primary) inputs absorbed by this industry. Such a subtotal, say, for industry j, is denoted as X_{Nj}. (Here, as elsewhere, "N" stands for "intermediate products" or "interindustry flows" and "j" denotes the destination of these flows.) We can think of this sub-total as being derived in two ways: one, as a sum of all inputs from other industries; two, by subtracting the Gross Product Originating in the j^{th} industry from its total output value (this second way of arriving at the sub-totals concerned follows from our definition of intermediate-product type inputs, which are independent of their origin of supply). Thus, we have

$$(19) \qquad X_{Nj} = \sum_i x_{ij} = X_j - Y_j$$

where

X_{Nj} = Total intermediate-product type (non-primary) inputs absorbed by industry j, in the Ohio River Basin

x_{ij} = Inputs absorbed by Ohio River Basin industry j from industry i (independent of whether it is produced by Ohio River Basin industry i or by the same industry located elsewhere)

X_j = Total output of Ohio River Basin industry j

Y_j = Gross Product Originating (primary inputs) in Ohio River Basin industry j

Assuming that Y_j is a fixed proportion, which we denote $(1 - a_{Nj})$, of X_j, we write:

$$(20) \qquad \frac{Y_j}{X_j} = 1 - a_{Nj}$$

Thus, from (19) and (20)

$$(21) \qquad X_{Nj} = a_{Nj} X_j \quad \text{or} \quad a_{Nj} = \frac{X_{Nj}}{X_j}$$

It should be noted that the assumption we have imposed here is less rigid than that used in input-output analysis, since substitutions between individual inputs and thus changes in individual coefficients are allowed, as long as the sum of all intermediate inputs is a fixed proportion of output.

Next, we take a sum over all the X_{Nj}'s and denote the resulting sum X_{NN}. Substituting from (21)

$$(22) \qquad X_{NN} = \sum_j a_{Nj} X_j$$

Now, we are ready to go back to equation (17) and consider the first term on the right-hand side, X_{iN}. For present purposes, we can assume that each X_{iN} ($i = 1, 2, \ldots\ldots, 27$) is a linear function of X_{NN} with two parameters (to be estimated separately for each of the 27 industries) as follows:

$$(23)^* \qquad X_{iN} = \bar{a}_{iN} + a_{iN} X_{NN} \qquad (i = 1, 2, \ldots\ldots\ldots, 27)$$

where X_{NN} is estimated from (22), above.

Using estimated values of X_{iN} ($i = 1, 2, \ldots\ldots\ldots, 27$) from the years 1947 and 1960, and estimated values of X_{NN} for the same years, we derive values for $\bar{a}_{iN}$ and a_{iN}, for each of the 27 industries. Here, as mentioned, estimates of X_{NN} for these two years are based on data regarding total outputs and GPO in each industry (as used in equations (20) and (22)).

Thus, assuming that numerical values have been assigned to the two parameters in equation (23), we have from (22) and (23):

$$(24)^{**} \qquad X_{iN} = \bar{a}_{iN} + \sum_j a_{iN} a_{Nj} X_j \qquad (i = 1, 2, \ldots\ldots\ldots, 27)$$

---

*As cross-checks on the calculations involved in (23), we impose the following two constraints on the estimated parameter values:

$$\sum_i \bar{a}_{iN} = 0 \qquad \text{and} \sum_i a_{iN} = 1 \; (i = 1, 2, \ldots\ldots\ldots, 27).$$

**For derivation of least square parameters $\bar{a}_{iN}$ and a_{iN}, see Chapter IV and Appendix F.

This concludes our discussion of the derivation of the X_{iN}'s for future years. As seen from (24), we have made these flows dependent on all the X_j's, in a way that cuts down on the data-gathering involved. Instead of the interindustry coefficients needed in an ordinary application of input-output analysis, we make use of 81 coefficients (27 times 3), and we believe firmly that, in addition to reducing the empirical work, our procedure improves the projections.

d. Household Consumption and Household Services

The second entry on the right-hand side of equation (17) concerns the demands of all Ohio River Basin households for different goods and services. It specifies a set of consumption coefficients which vary over time as between the individual commodity items and total consumption, as illustrated in the following expression for the year 1970:

$$(25) \qquad \frac{C_i^{70}}{C_{ORB}^{70}} = c_i^{70} \quad (i = 1, 2, \ldots\ldots\ldots\ldots, 27)$$

where

C_i^{70} = Ohio River Basin household consumption of products from the i^{th} industry, 1970

C_{ORB}^{70} = Total Ohio River Basin household consumption of all goods and services, in 1970

c_i^{70} = Proportion of total Ohio River Basin household consumption spent on products from the i^{th} industry, in 1970

Thus, given the proportionality coefficient on the right-hand side of (25), household demand for products from the i^{th} industry is estimated and projected on the basis of total consumption demands for all products and services. In turn, these total consumer demands are derived on the basis of projections of Disposable Income which in turn is related to projections of Personal Income.

We now make explicit two of our major but highly plausible assumptions, first, that the ratio of Ohio River Basin Household Consumption (C_{ORB}) to Ohio River Basin Disposable Income ($Y_{d\,ORB}$) is always the same as United States Household Consumption (C_{US}) to United States Disposable Income ($Y_{d\,US}$), or

(25-1) $$\frac{C_{ORB}}{Y_{d\,ORB}} = \frac{C_{US}}{Y_{d\,US}}$$

and, second, that the ratio of Ohio River Basin Disposable Income to Ohio River Basin Personal Income ($Y_{p\,ORB}$) is always the same as the ratio of United States Disposable Income to United States Personal Income ($Y_{p\,US}$), or

(25-2) $$\frac{Y_{d\,ORB}}{Y_{p\,ORB}} = \frac{Y_{d\,US}}{Y_{p\,US}}$$

By restating equations (25-1) and (25-2) in the form

$$\frac{C_{ORB}}{C_{US}} = \frac{Y_{d\,ORB}}{Y_{d\,US}} \qquad \text{and} \qquad \frac{Y_{d\,ORB}}{Y_{d\,US}} = \frac{Y_{p\,ORB}}{Y_{p\,US}}$$

and applying these equalities to national consumption and income equations

(26)* $$C_{US} = 10.2700 + .8856Y_{d\,US} + .1444t$$

where:

$Y_{d\,US}$ = U. S. Disposable Income

t = time: 1929 = 0

and

(27)* $$Y_{d\,US} = 2.8057 + .8380Y_{p\,US} - .7554t$$

where, again, t = 0 for 1929

we get:

(26-1) $$C_{ORB} = Y_{d\,ORB}\left(\frac{10.2700}{Y_{d\,US}} + .8856 + \frac{.1444t}{Y_{d\,US}}\right)$$

---

*For derivation of parameter values, see Table VI, Appendix C.

$$(26\text{-}2) \qquad \alpha_{US} = \left(\frac{10.2700}{Y_{d\ US}} + .8856 + \frac{.1444t}{Y_{d\ US}} \right.$$

$$(26\text{-}3) \qquad C_{ORB} = Y_{d\ ORB} \cdot \alpha_{US}$$

and

$$(27\text{-}1) \qquad Y_{d\ ORB} = Y_{p\ ORB} \left(\frac{2.8057}{Y_{p\ US}} + .8380 - \frac{.7554t}{Y_{p\ US}} \right)$$

$$(27\text{-}2) \qquad \beta_{US} = \left(\frac{2.8057}{Y_{p\ US}} + .8380 - \frac{.7554t}{Y_{p\ US}} \right)$$

$$(27\text{-}3) \qquad Y_{d\ ORB} = Y_{p\ ORB} \cdot \beta_{US}$$

Thus we see that through substitutions of (27-3) and (26-3) into (25) we can write the more general functional relationship as:

$$(28) \qquad C_i^{70} = f \left(Y_{p\ ORB}^{70} \right) \qquad (i = 1, 2, \ldots\ldots\ldots, 27)$$

How, then, can total Personal Income be derived? We now refer to expression (19), where we introduced the concept of Gross Product Originating (GPO).

For each industry, we estimate the proportion of GPO which accrues to households (Y_{pj}):

$$(29) \qquad \frac{Y_{pj}}{Y_j} = h_j \qquad (j = 1, 2, \ldots\ldots\ldots, 27)$$

By summing in (29) over all 27 industries, we have:

$$(30) \qquad \sum_j Y_{pj} = \sum_j h_j Y_j$$

In turn, (30) relates to total Personal Income in 1970 as follows:

(31) $$Y_p^{70} = \sum_j h_j Y_j^{70} + Y_{G_1}^{70} + Y_{G_2}^{70}$$

where

Y_p = Total Personal Income in the Ohio River Basin.

h_j = Household income proportionality coefficient for Ohio River Basin industry j.

Y_j = Gross Product Originating in Ohio River Basin industry j.

Y_{G_1} = Wages and salaries, interest and other transfer payments from federal non-defense government agencies, and from state and local governments, accruing to Ohio River Basin households.

Y_{G_2} = Payrolls and other payments from federal defense agencies (including payrolls to armed forces and related personnel), accruing to Ohio River Basin households.

As already stated in expression (20), the GPO's are related in a simple way to the industry outputs. Payrolls, etc., from federal defense agencies are projected extraneously. Income (including transfer payments) accruing to households from government agencies (federal, state and local) for non-defense work is derived on the basis of

(32) $$Y_{G_1} = pG_1$$

p = Household proportionality coefficient for non-defense government expenditure

G_1 = Non-defense expenditures by government agencies (federal, state and local)

and

(33) $$G_1 = \gamma Y_{p\ ORB}$$

γ = Exogenously derived proportionality coefficient determining the relation between government non-defense expenditures and total personal income

In this case p is assumed to be a constant while γ is projected to change over time.

e. Capital Investment

Going back to equation (17), we see that entry #3 on the right-hand side specifies usage for investment purposes. In other words, for every industry output we are stating here that portion of it (if any) which constitutes investment or capital formation. This comprises capital formation as represented by expenditures on new Construction, expenditures for Plant and Equipment, and Inventory Changes (which can be positive or negative). Capital formation items are determined and projected on the basis of corresponding national categories and their projections. For a detailed discussion, see Chapter IV and Appendix E-5.

f. Net Trade

Returning to equation (17), it may seem puzzling at first glance that on the left-hand side of (17) we have the total Ohio River Basin output of any industry i, whereas on the right-hand side we have the total usage (i.e. purchases) of the products from industry i, regardless of whether they are produced in the Ohio River Basin or elsewhere. The entry headed "Net Trade" gives the answer. It states the net difference between exports out of the Ohio River Basin and imports into the Ohio River Basin of products of the industry i type. If other entries on the right-hand side of (17) exceed, in total, the value of the left-hand side, we find a negative entry which makes up the difference under the heading Net Trade. If all other items combined have a smaller value than the output value on the left-hand side, we find a positive entry ("exports") under Net Trade.

Altogether, seven out of the 27 Ohio River Basin industry sectors have relatively large exports out of the region to the rest of the U. S. and to foreign countries. These are: Coal Mining; Chemicals and Allied Products; Stone, Clay and Glass Products; Steel; Fabricated Metal Products; Machinery except Electrical Machinery; and Electrical Machinery. For these industries, projections of Net Trade are made by relating Ohio River Basin growth prospects directly to national growth trend projections.

All other industries have Net Trade entries expressed as a constant proportion of total output.

Thus, to summarize, except for the export industries, Net Trade entries are assumed to be determined by proportionality coefficients, applied to total outputs:

$$E_i^{70} = e_i X_i^{70}$$ (for all industry sectors except export industries listed above)

g. Government

As mentioned earlier, we separate defense expenditures from all other government expenditures. Defense expenditures are projected on the basis of national data. Total non-defense expenditures (of federal, state, as well as local governments) G_1 in the Ohio River Basin are related to Personal Income as defined in expression (33).

These government expenditures comprise both payments to households denoted as Y_{G_1} in expression (32) and payments for purchases of goods and services from individual industry sectors.

Having obtained total non-defense expenditures by government agencies, we assume that their distribution over the 27 industries has a fixed pattern which we here denote by a set of proportionality coefficients g_i $(i = 1, 2, \ldots\ldots\ldots, 27)$.

Thus, finally, we can write

$$(35) \qquad G_{1i}^{70} = g_i G_1 \qquad (i = 1, 2, \ldots\ldots\ldots, 27)$$

The distribution pattern is that of the state and local government expenditures distribution as derived from the 1947 national input-output table.

By carrying out successive substitutions into equation (17), all entries on the right-hand side of this equation can now be expressed in terms of (a) exogenous variables, (b) fixed parameters or coefficients and (c) the X_i's. Thus, we have a system of 27 linear equations describing the gross output levels of 27 industry sectors.

The final working equation for any i^{th} industry for, say, the year 1970 can thus be expressed as follows:

$$(35) \qquad X_{i\,ORB}^{70} = \sum_{j=1}^{27} a_{iN} a_{Nj} X_{j\,ORB}^{70} + \left(c_i \alpha_{US}^{70} \beta_{US}^{70} + g_i \gamma_{US}^{70} \right) \left[\sum_{j=1}^{27} \frac{h_j (1 - a_{Nj}) X_{j\,ORB}^{70} + Y_{G_2\,ORB}^{70}}{1 - p\,\gamma_{US}^{70}} \right] + \bar{a}_{iN} + I_{i\,ORB}^{70} + E_{i\,ORB}^{70} + G_{2i\,ORB}^{70}$$

Once a solution for each "$X_{i\ ORB}$" is obtained, through equations of the form (35), we can easily derive such magnitudes as Personal Income of Basin households, non-defense government expenditures, and total labor demands, through appropriate substitutions in the equations presented previously. This is further discussed in Chapter IV.

3. Operation of the Model in Making Projections

In summarizing the discussion of the model structure, we can state that the model is composed of thirty-five basic relationships which represent numerous equations for each of the industry sectors.

How do these relationships function when the model is used to project future output for each industry? It is not practical to give a step-by-step account of the mathematical operations which occur in the computer as the set of simultaneous equations is solved for a given set of data. Essentially the computer does no more than determine the value of the unknown variables for a set of equations which presumably characterize, in highly abstract form, the behavior and interaction of the major forces at work in the 'real-world' regional economy.

Thus starting with our key equation (17) in equilibrium, the values of certain exogenous variables (i.e. those determined outside the system) are changed. I_i and G_{2i} are examples of such exogenous variables. These changes cause changes in other variables which in turn alter the values of still other variables until the equation is again in an equilibrium position. In a sense, the model enables the computer to simulate in a highly simplified form the complex process of adjustment which takes place in the economic system as certain forces initiate an action to which other forces react. Reconciliation of the supply of labor with the demand for labor represents the final balancing off of the two countervailing forces.

C. SUBAREA PROJECTION METHOD

In order to select a method for deriving projections of economic activity for the 19 subareas of the Ohio River Basin, we established another set of objectives. We sought a method which, first, would reflect the effects of some of the forces that are likely to shape the future course of economic growth in individual subareas and, second, would lend itself to distributing the projected activity of 29 employment sectors among the 19 subareas for which only a minimum of historical data exists. In broad terms, the subarea model should reflect:

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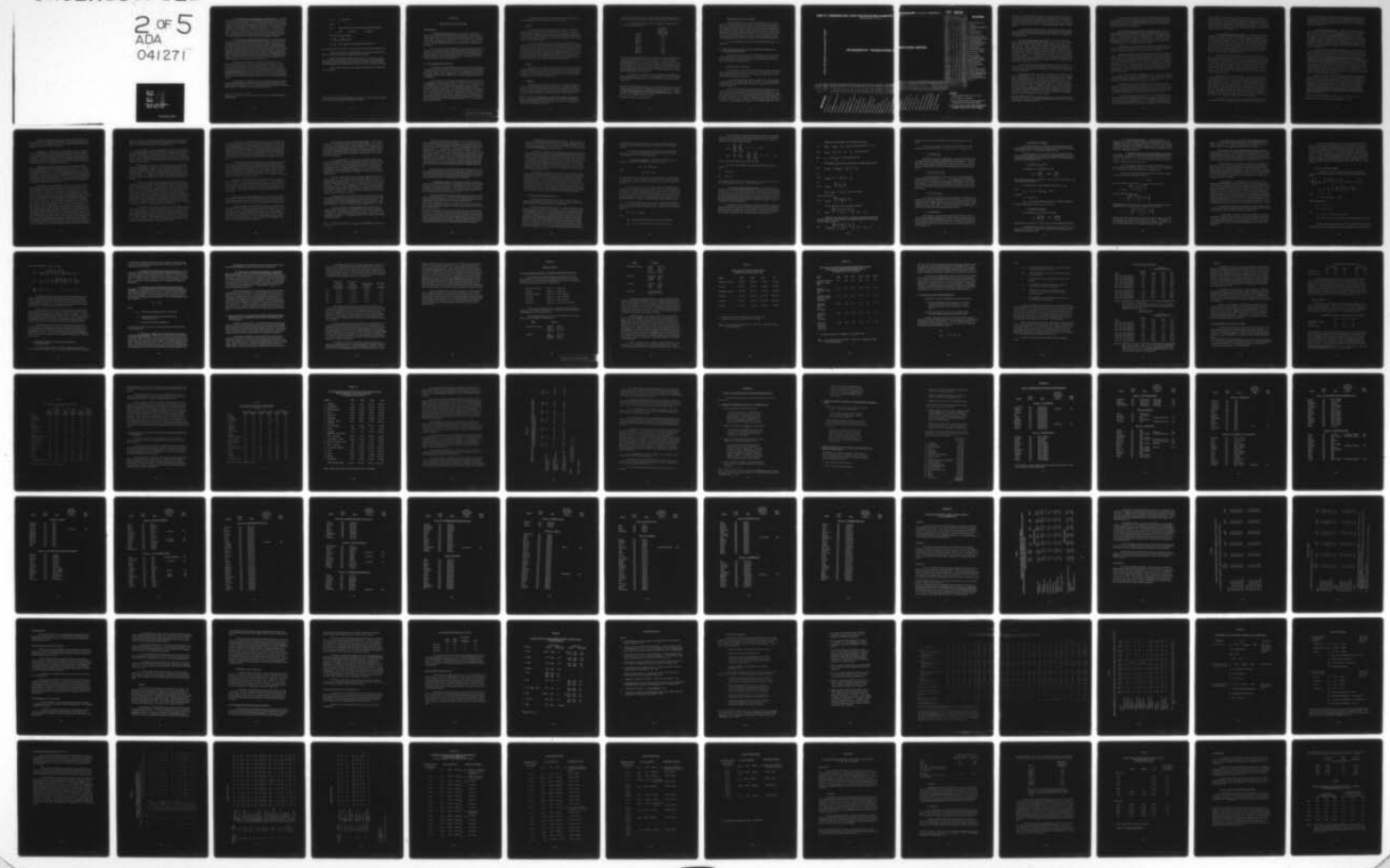
OHIO RIVER BASIN COMPREHENSIVE SURVEY. VOLUME III. APPENDIX B. --ETC(U)
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(1) The dependency of subarea growth on regional growth. The method should enable us to relate economic development in each subarea to growth prospects for the region as a whole. As we have previously noted, there is a tendency for small areas to be more dependent upon economic influences from outside of the area than upon interindustry relationships within the area. This dependency or "openness" of small subareas is essentially a reflection of the lack of self-sufficiency which is overcome by means of trade linkages, that is, exports and imports. It should be noted, in this connection, that when we speak of small areas we do not necessarily refer to their physical size but rather to the total volume of economic activity which takes place within given geographic boundaries.

(2) The element of competition among subareas. The projected growth pattern for each subarea should reflect not only the competitive advantage or disadvantage enjoyed by industry in the subarea vis-à-vis other subareas, but also the extent to which the subarea contains industries of slow or rapid growth potential. Thus, the allocation of sectoral economic activities in the Ohio River Basin among the subareas will determine their relative growth patterns. It is necessary, furthermore, that the method selected enable us to give decreasing weight to the momentum of growth or decline which carries a subarea's relative growth forward in time. Growth momentum is largely the result of economies of agglomeration. Similarly, the forces of decline tend to be slowed down by the simple process of reducing an area's economic activity to a minimal level.

Finally, the method must be tailored to the availability of data for county-delineated subareas and it must be simple enough to enable us to carry out a very substantial number of allocation operations in a systematic manner. For the most part, detailed historical data on our subareas can be built up only from the decennial census of population. Additional information is available from County Business Patterns* for the years 1956, 1959 and 1962, but it does not always lend itself to reconciliation with data from other sources. At most, only 6 historical data points exist upon which judgments about the subarea's growth trends can be based.

To accomplish all of these objectives, we decided to distribute the basin-wide output and employment projections among the 19 subareas by fitting a least-squares regression equation to historical subarea shares of employment in individual industry sectors. The general form of the equation used was:

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*Prepared by the Bureau of the Census with the assistance of the Social Security Administration.

$$Y_{xi} = a_{xi} + b_{xi} \log (t)$$

where:

Y_{xi} = subarea share of an industry (subarea/Ohio River Basin)*

t = time x = subarea i = industry

with the following constraint:

$$Y_i = \sum_x a_{xi} + \sum_x b_{xi} \log (t)$$

where Y_i = total employment in Ohio River Basin industry i.*

This constraint insures that the sum of the subarea shares adds up to the Basin total.

The log of time exerts a dampening effect upon any growth momentum implied in the historical relationship represented by the equation.

Where subarea industry shares turned out to be very small, e.g., less than one percent of the Ohio River Basin industry employment, they were generally held constant. Minor adjustments were also made for specific industries beset by data limitations, and other adjustments were necessary to achieve overall consistency.

Finally, population growth was related to projected growth in employment for each subarea.

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*The notations used in this equation differ in meaning from those used in the description of the econometric model for the Basin as a whole.

CHAPTER IV

IMPLEMENTATION OF THE MODEL

INTRODUCTION

A description of the operational or "how-to-do-it" procedures is necessary to provide the link between the model framework, as presented in Chapter III, and the results of the projections given in Chapter II. The purpose of this chapter, therefore, is to outline the major procedures required to make the Ohio River Basin projection model work. For the sake of clarity and conciseness, detailed descriptions of these procedures have been relegated to the Appendices.

In broad terms, the operational process can be divided into the following phases: (A) Derivation of a demographic projection of the population and labor force; (B) Derivation of base-year values, projection parameters, and demand projections; and (C) Reconciliation of the results of the demographic projection with the results of the demand projections. These phases are described individually in the following sections.

A. THE DEMOGRAPHIC PROJECTION

The purpose of the demographic projection is to provide an independent estimate of the future population of the Ohio River Basin from which estimates of the future supply of labor can be derived. The demographic projection thus provides the regional model's supply element to be subsequently reconciled with the demand element in order to achieve an "equilibrium" population projection for the Basin.

The method used for the independent population projection is known as the component or cohort-survival method. It is widely used because of two important advantages over alternative projection methods. First, it permits separate empirical assessments of the three components of population change -- fertility, mortality, and migration -- for the specific population under consideration. Second, because these components all vary with age and sex, it utilizes age-sex distributions in its procedures. Operationally, the sequence is as follows: beginning with the known age-sex groupings of a base-year population, we add estimated numbers of future births, subtract estimated numbers of future deaths, and either add or subtract estimated numbers of in- or out-migrants to generate the projection.

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The assumptions made for projecting each of the three components of population change in the Ohio River Basin are set forth below:

1. Births

The national experience during the last two decades has made the variability of the fertility component abundantly clear to everyone. Since we have no satisfactory guide to long-term trends in the population's reproductive characteristics, we decided to follow the assumptions made by the Bureau of the Census in Series III of its illustrative projections of the population of the United States with only slight variations.*

For our base-year data, we used the 1960 age-specific birth rates estimated by us for the Ohio River Basin instead of the 1955 national age-specific birth rates used by the Bureau of the Census. In the national projection, fertility is assumed to decline from the 1955-57 level to the 1949-51 level by 1965-70 and to remain at this level to 1975-80; it is then assumed to decline further to the 1942-44 level by 1995-2000, at which level it is kept until 2005-2010. In the Ohio River Basin projection, we assumed that the regional birth rate computed for 1960 would fall to the 1949-51 national level by 1965-70, and would then continue to decline at the same rate as in the national Series III projection.

2. Deaths

The mortality, or survival, factor is the most stable of the components of population change. For the Ohio River Basin projection, we followed the age-specific mortality assumptions used by the Bureau of the Census in its national projections. They represent an average of the high and low mortality estimates developed by the Social Security Administration.

3. Migration

The migration factor is more variable and more difficult to measure than the two other components whenever projections for subnational regions are required. Whereas national patterns of migration are regulated by restrictive laws which tend to hold volume of movement to a fairly stable minimum, migration across regional boundaries is totally unregulated; it ebbs and flows in

*Bureau of the Census, Illustrative Projections of the Population of the United States, by Age and Sex, 1960-80, Series P-25, No. 187, 1958, as adjusted for actual age-sex distribution in Census of 1960; and unofficial Census Bureau extension of age-sex distribution to 2010.

response to varying local conditions. Because the inherent uncertainties are so great, the selection of migration assumptions is always more or less arbitrary.

For the Ohio River Basin, historical changes in migration volumes are shown in the following table:

Decade	Estimated Migration Per 1,000 Average Population*
1870-80	-13.0
1880-90	- 6.7
1890-00	+14.3
1900-10	+11.3
1910-20	+16.1
1920-30	-18.8
1930-40	-22.3
1940-50	-39.4
1950-60	-49.8

Since net out-migration appears to have increased every decade since the 1920's we have assumed that this movement would continue into the future but at a steadily decreasing rate, and that it would reach zero shortly after the end of the projection period. This decline in out-migration over the 50-year projection period is based on the widely held expectation that rates of growth in all areas of the United States will tend to draw closer to each other as the country reaches maturity and the Ohio River Basin's relative disadvantage (in terms of economic opportunity) gradually lessens with time.

The effect of our assumptions is that the population of the Ohio River Basin, which constituted 14.4% of the U.S. population** in 1900 and had dropped to 10.6% by 1960, would account for 9.3% of the nation's total in 1980, and for 8.4% in 2010.

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*Adjusted for the geographical boundaries of the Ohio River Basin from historical migration rates for each state computed by Lee, Miller, Brainerd and Easterlin in Population Redistribution and Economic Growth, 1870-1950, Vol. 1, Table P-1, page 107. The migration rate for 1950-60 was estimated by Arthur D. Little, Inc., using the same computation methods as above.

**Contiguous territory of the United States.

Demographic Labor Force Projection

The regional labor force was projected by applying to our projected Ohio River Basin population the same age-sex labor force participation rates as those used to project the future size of the U.S. labor force (see Appendix C). Some adjustments were necessary to take account of the Basin's somewhat lower than national participation rates in 1960, and to make allowance for differences between Bureau of Labor Statistics participation rates and the rates derived from the Census of Population, which is the source of all control data for this study. After making these adjustments, it was assumed that the gap between national and Basin participation rates would narrow and be virtually eliminated by 2010.

For the demographic projection tables and detailed methodology, see Appendix D.

B. DERIVATION OF BASE YEAR VALUES, PROJECTION PARAMETERS, AND DEMAND PROJECTIONS

Four basic steps are involved: (1) Determination of base year values for the model framework; (2) Derivation of projection parameters; (3) Computer solution of the model; (4) Determination of employment and labor force projections with given output projections.

1. Derivation of Base Year Values

A comprehensive grasp of the Ohio River Basin's economy is essential when a regional 50-year projection is contemplated. Since the base year values represent the foundation for almost all of the subsequent steps, their accurate determination is particularly important.

As was explained in Chapter III, this study gives form to the region's economy in terms of a modified input-output framework. It is within this framework that the interrelationships of sectors within the regional economy are described and measured.

Given the framework, the interrelationships between the various sectors of the Basin's economy can be presented in tabular form (Table IV-1). It can be seen at once that, unlike the typical tables showing interindustry relations, this table has no entries for the value of shipments from any one industry sector to any other industry sector. In addition to giving total gross input and gross output values, Table IV-1 shows only the row entries for primary input values and the row entries for aggregated non-primary or intermediate input values on the

TABLE IV-1 AGGREGATED INPUT-OUTPUT TABLE FOR THE OHIO RIVER BASIN, 1960

Intermediate Output

Intermediate (non-primary) Input

INTERMEDIATE TRANSACTIONS M

INDUSTRIES		1. Agriculture, Forestry & Fisheries	2. Coal Mining	3. Other Mining (metals, crude oil, minerals)	4. Construction	5. Food & Kindred Products	6. Textile Mill Products	7. Apparel & Finished Products	8. Lumber & Wood Products-furniture & Fixtures	9. Paper and Allied Products	10. Printing, Publishing & Allied Products	11. Chemicals & Allied Products	12. Petroleum Refining	13. Rubber & Miscellaneous Plastics	14. Stone, Clay & Glass Products	15. Ferrous Metals	16. Non-Ferrous Metals	17. Fabricated Metal Products	18. Machinery, except Electrical	19. Electrical Machinery	Transportation Equipme
Total Intermediate (non-primary) Input		2,707.9	336.8	293.2	4,522.8	4,792.2	144.3	422.6	744.0	836.1	615.6	2,433.6	856.9	501.8	1,188.2	5,614.0	870.0	38	2,296.5	2,576.3	
Primary Input or Gross Product Originating (GPO)	Household Income	1,064.7	748.2	86.2	1,599.1	962.5	77.4	259.2	388.4	299.8	580.8	723.4	65.5	228.2	778.9	2,088.1	282.5	989.2	1,353.8	1,385.9	
	Government & Other	737.8	306.1	687.3	1,052.2	636.2	10.6	15.1	52.9	111.0	112.1	763.8	78.0	104.4	303.8	646.8	125.5	307.9	379.6	541.8	
TOTAL GROSS INPUT		4,510.4	1,391.1	1,066.7	7,174.1	6,390.9	232.3	696.9	1,185.3	1,246.9	1,308.5	3,920.8	1,000.4	834.4	2,270.9	8,348.9	1,284.8	3,370.9	4,029.9	4,504.0	
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	

RIVER BASIN, 1960 (in millions of 1960 dollars)

rput

ISACTIONS MATRIX

ENDOGENOUS SECTORS			EXOGENOUS (FINAL DEMAND) SECTORS			
Total Inter-mediate Output	House-Hold Consump. Exp	Govt Non-Defense Exp	Govt Defense Exp	Invest-ment **	Net Trade	Total Gross Output
3,089.0	1,234.9	5.8	1	63.4	117.2	4,510.4
207.7	—	13.1	5.7	1.6	1,163.0	1,391.1
1,377.2	21.6	0.1	0.1	10.1	- 342.4	1,066.7
2,346.9	26.9	1,228.2	52.9	4,049.7	- 530.5	7,174.1
3,286.6	3,332.2	15.3	25.7	53.0	- 321.9	6,390.9
517.4	190.3	5	2.5	6.4	- 484.8	232.3
180.4	1,421.5	11.0	34.4	- 2.9	- 947.5	696.9
1,043.3	287.6	4.5	5.8	65.9	- 221.8	1,185.3
1,463.1	70.4	9.6	3.7	36.5	- 336.4	1,246.9
1,033.8	327.4	25.5	10.8	- 5.6	- 83.4	1,308.5
3,159.0	449.1	12.0	29.2	48.8	222.7	3,920.8
820.3	721.5	15.8	51.6	- 2.8	- 606.0	1,000.4
674.9	168.6	2.5	7.4	- 4.4	- 14.6	834.4
1,240.0	417	1.8	3.4	79.9	904.1	2,270.9
4,834.1	—	2	16.4	335.5	3,162.7	8,348.9
1,277.2	5.3	—	8.6	57.9	- 64.2	1,284.8
2,365.7	129.7	6.2	21.6	143.8	703.9	3,370.9
1,839.8	96.4	27.9	84.6	1,696.5	284.7	4,029.9
1,538.8	330.8	2.6	226.9	1,131.0	1,273.9	4,504.0
757.2	70.1	1.2	606.3	251.8	- 216.9	1,469.7
1,484.8	898.8	36.0	121.8	696.1	109.6	3,347.1
681.5	531.0	2.5	12.4	28.6	- 47.0	1,209.0
670.8	480.3	11.6	213.4	66.0	- 693.0	749.1
4,683.0	1,950.9	76.4	13.8	83.0	- 374.2	6,432.9
3,487.8	6,443.9	4.4	8.2	468.2	- 322.5	10,090.0
4,064.3	7,046.2	27.1	1.6	168.7	-2,550.4	8,757.5
2,978.1	4,391.0	1,879.1	278.3	146.2	- 803.4	8,869.3

2	5,614.0	81.0	3.8	2,296.5	2,576.3	813.5	2,583.5	868.6	433.1	2,400.2	3,683.1	3,178.4	3,308.9	51,102.7
9	2,088.1	282.5	989.2	1,353.8	1,385.9	509.9	642.2	157.7	234.5	2,608.6	5,034.8	4,735.9	3,656.7	31,542.1
8	646.8	125.5	307.9	379.6	541.8	146.3	121.4	182.7	8	1,424.1	1,372.1	843.2	1,903.7	13,047.9
9	8,348.9	1,284.8	3,370.9	4,029.9	4,504.0	1,469.7	3,347.1	1,209.0	749.1	6,432.9	10,090.0	8,757.5	8,869.3	95,692.7
	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	

Ferrous Metals
Fabricated Metal Products
Machinery, except Electrical
Electrical Machinery
Transportation Equipment
Motor Vehicles
Tobacco & Leather Products
Ordnance, Instruments & Misc. Mfg.
Transportation, Communication & Utilities
Trade (wholesale & retail)
Finance, Insurance & Real Estate
Services

INDUSTRIES

1. Agriculture, Forestry & Fisheries
2. Coal Mining
3. Other Mining (metals, crude oil, minerals)
4. Construction
5. Food & Kindred Products
6. Textile Mill Products
7. Apparel & Finished Products
8. Lumber & Wood Products, Furniture & Fixtures
9. Paper & Allied Products
10. Printing, Publishing & Allied Products
11. Chemicals & Allied Products
12. Petroleum Refining
13. Rubber & Miscellaneous Plastics
14. Stone, Clay & Glass Products
15. Ferrous Metals
16. Non-Ferrous Metals
17. Fabricated Metal Products
18. Machinery, except Electrical
19. Electrical Machinery
20. Transportation Equipment
21. Motor Vehicles
22. Tobacco & Leather Products
23. Ordnance, Instruments & Misc. Mfg.
24. Transportation, Communication & Utilities
25. Trade (wholesale & retail)
26. Finance, Insurance & Real Estate
27. Services

LEGEND:

— *Negligible (below $50,000) or does not exist*

X *Not available or not needed*

* *Payments to government, plus all other payments on capital account and miscellaneous charges.*

** *Consisting of new construction, producers' durable equipment, miscellaneous charges, and net inventory changes.*

input side. The former comprise payments by industries to households and government as well as purchases on capital account, while the latter represent outlays for goods and services purchased from other industry sectors. On the output side, on the other hand, Table IV-1 shows values for each of the major final demand or output columns as well as for the total intermediate output or demand column.

As noted in Chapter III, this form of describing interindustry relations reduces the data requirements and thus makes the framework for the Ohio River Basin operational. The entries for which base year values had to be determined are explained below.

(a) Gross output and gross input levels. The essence of an input-output table is that gross output be equal to gross input. In other words, for any given year the total value of any industry sector's output must be equal to the total value of its inputs. Thus, the derivation of one value automatically determines the other, and the derivation can be made from either the production or the income side. The gross output of an industry, as given in Table IV-1, measures the sum total value of an industry's annual production as it is distributed to all sectors of the economy, including shipments to itself. Outputs are expressed in producer's values, i.e., in prices f.o.b. plant. Whatever values are added to the product in the process of distribution by the transportation, wholesale, and retail sectors are margins which accrue as output values to the industries which provide these particular services.

Gross output levels for Ohio River Basin industry sectors for 1960 were derived, first, by updating an aggregated 27-industry-sector version of the 1947 U.S. input-output table to 1960, and second, by scaling down national totals to regional dimensions.

In updating our values, the 1960/1947 growth indices of national gross product originating were used. For scaling, we applied the region's employment share of national employment in each of the major one-digit SIC sectors. Within the one-digit manufacturing sector, output levels for individual industries were determined on the basis of the 1960 percentage distribution of the value of shipments for individual industries in the Ohio River Basin. The value of shipments for 1960 was derived, in turn, by updating 1958 data obtained from a special tabulation of the Census of Manufactures for the counties encompassed by the Ohio River Basin.* Indices for updating the 1958 value of shipments were calculated on the basis of the 1958-60 increase in value added by individual manufacturing industries in the principal states within the region.

*The special tabulation of 1958 Census of Manufactures data was undertaken by the Bureau of the Census under an agreement with the Corps of Engineers, U.S.Army, at the request of Arthur D. Little, Inc.

The resulting 1960 gross output levels for individual industry sectors in the Ohio River Basin were then checked against the results obtained from other derivation methods. Since no significant differences were found, the initial value estimates were accepted. For a more detailed description of the derivation of base year parameters, see Appendix E-1.

(b) Derivation of Intermediate Output or Demand Column. The intermediate output or demand column in Table IV-1 shows the total dollar value of all the intermediate goods and services which flow from any "individual industry sector" to "all other industry sectors, including itself." These flows are intermediate in that they represent inputs to all other industries, but do not include the shipments of goods to the final demand sectors which are represented by the household, government, investment, and trade columns.

The distinctive characteristic of the interindustry relations table constructed for this study is that it shows the total value of intermediate shipments and not the individual components or specific interindustry linkages.

Intermediate output or demand values are also expressed in producer's prices. They were derived for 1960 from national figures in a sequence which is similar to that used for determining gross output values. The following steps were required: (1) Determination of 1947 national gross output levels for equivalents of the 27 Ohio River Basin industry sectors; (2) Application of 1947 Ohio River Basin/U.S. industry sector employment shares to these values; (3) Application of the 1947 U.S. input-output matrix to Ohio River Basin 1947 gross input totals in order to derive 1947 intermediate output totals for the Basin; and (4) Multiplication of 1947 intermediate demand values by the 1960/1947 index of growth in gross output.

The first step required a reaggregation of the U.S. 200-sector national input-output table into 27 Ohio River Basin industry sector equivalents; the second step required the determination of 1947 Basin/U.S. employment shares for these 27 sectors. Both steps are described in detail in Appendix E-2.

In the third step it was assumed that the 1947 national interindustry matrix would also be representative of the economy of the Ohio River Basin for that year. This assumption appears defensible in view of the fact that the region contains approximately ten percent of the nation's economic activity and reflects an industry mix bearing great similarity to that of the nation as a whole.

In step four we assumed that between 1947 and 1960 intermediate demand levels increased at about the same rate as total gross output in the same period. In view of the fact that total sales for intermediate consumption generally accounts for a substantial share of the gross output of most industrial sectors, this assumption appeared reasonable for achieving preliminary estimates.

These estimates of intermediate demand totals for 1960 were subsequently adjusted in the process of reconciling the independently computed intermediate and final demand sector totals with the 1960 regional gross output levels. This adjustment consisted of distributing to the intermediate output and net trade columns whatever residual differences were found between gross output levels and the sum of the separately computed intermediate and final demand sectors. For details of these procedures, see Appendix E-2.

(c) Household Consumption Expenditures. The household consumption expenditures column of Table IV-1 records total consumption expenditures by households in the Ohio River Basin and their distribution among the 27 industry sectors which produce goods and services. Since regional consumption expenditure data were not available, the basic reference sources used to determine the breakdown of regional consumption expenditures among commodity categories were the federal government's annual statistics on national income components. There was no reason to believe that Ohio River Basin household consumption expenditure patterns would differ significantly from national patterns; hence the decision to use national data appeared reasonable.

Two basic computational steps were required to determine the entries for the household consumption column of Table IV-1: (1) total consumption expenditures in the Ohio River Basin were derived by applying the national consumption expenditures/disposable income ratio for 1960 to regional disposable income; (2) consumption expenditure categories were distributed among the 27 industry sectors. Since individual expenditure entries in the table must reflect the shares of specific consumption expenditure categories accruing to individual industry sectors, certain adjustments were needed to translate commodity expenditure categories into sectoral flows. This step, which turned out to be very intricate, calls for further explanation.

In keeping with the concept of producers' values, individual consumption expenditure categories had to be apportioned among individual industry sectors on the basis of the value contributed by each industry to each household commodity expenditure category. In other words, specific margins had to be assigned to the so-called distribution industries, which in the table appear as the retail, wholesale and transportation sectors. The adjustment was carried out with the help of a supplemental table to the 200-sector national input-output table for 1947. This supplemental table provided conversion ratios for translating commodity expenditure categories into industry sector flows. With household expenditures broken down into 52 commodity or service groups, it became possible to convert consumption expenditures into industry output flows.

To the extent that relative prices or commodity mixes within individual consumption expenditure categories have changed between 1947 and 1960, our

conversion will not produce accurate results for 1960. However, since our industry sectors are aggregated to the one- or two-digit SIC level, the effect of changes that may have occurred since 1947 is not likely to be as significant among the industry sectors as within any one of the sectors. For operational details, see Appendix E-3.

(d) Government Expenditures. Table IV-1 divides government expenditures into two categories: nondefense expenditures and defense expenditures. The first category contains all nondefense expenditures of the federal government as well as all the expenditures of state and local governments. (No attempt was made to segregate the defense expenditures of state and local governments since they are known to be of negligible magnitude.) Nondefense expenditures comprise all payments by government agencies to industry for the purchase of nondefense goods and services (including interest and subsidy payments), as well as payments to households, mainly in the form of salaries and wages or of subsidies.

In order to estimate nondefense expenditures by government for 1960 in the Ohio River Basin, it was necessary to conduct separate computations for federal expenditures on the one hand and for state and local expenditures on the other. In deriving these estimates, heavy reliance was placed on a special Library of Congress study, Federal Revenues and Expenditures in the Several States, Averages for the Fiscal Year 1959 and 1961, conducted by I.M. Labovitz.* This study allocates various categories of government expenditures among the 50 states. We refined the study's allocations to the 10 Ohio River Basin states by dividing them into Basin and non-Basin shares, using such factors as Basin and non-Basin employment in various government activities for purposes of apportionment. In order to distribute nondefense expenditures among the 27 industry sectors, it was decided to apply the distribution pattern of state and local government expenditures given in the 1947 national input-output table.

The second category, government defense expenditures, appears in a separate column in Table IV-1. It comprises federal defense expenditures for the procurement of weapons and the operation and maintenance of military installations. The Library of Congress study again was used to determine defense expenditures for the region as a whole. The distribution of these expenditures among the 27 industry sectors for 1960 was in turn derived from a county-by-county tabulation of published primary federal contract awards compiled by Walter Isard and James Ganshow: Awards of Primary Military Contracts by County, State and Metropolitan Area of the United States, Fiscal Year 1960.** (See also Appendix E-4).

*Library of Congress Legislative Reference Service, September 19, 1962.

**Regional Science Research Institute, Philadelphia, Pa., 1962.

The level of government expenditures to households for 1960 thus derived was found to be consistent with estimates of government payments to households derived from a breakdown of sources of per capita income provided by the Department of Commerce for the Basin states.

(e) Investment. Value entries in the investment column of Table IV-1 represent that portion of output which flows from industries into the investment or gross capital formation sector of the regional economy. The investment sector therefore represents essentially all the capital purchases by industries and households, including (1) expenditures on new construction in the private sector; (2) industry expenditures on plant and equipment; (3) miscellaneous charges to capital accounts; and (4) net changes in inventories.

Conceptually, the capital investment sector of the Ohio River Basin model is similar to that of the 1947 national 200-sector interindustry relations table except that inventories are listed separately in the latter. As is the custom in all input-output frameworks, investments of a purely financial nature, as well as purchases of used assets or land, are excluded from consideration. Moreover, the general rule of a three-year useful life is used to identify capital expenditures. Any differences which may exist between our concept of investment and that used in the national table would be primarily due to data deficiencies encountered in deriving 1960 regional investment estimates.

The derivation was accomplished as follows: First, it was assumed that the 1947 computations of national gross private capital formation (i.e., the sum of expenditures on new private construction, producers' durables, etc.), aggregated into a 27-industry-sector framework, constituted the most comprehensive and accurate compilation of such data for input-output purposes to date. Second, 1947 gross capital formation equivalents for the Ohio River Basin were derived by assuming that the Basin's percentage share of national gross capital formation for each industry sector was approximately equal to its share of national gross output in that sector. Third, the Basin's capital formation totals for 1960 were determined by assuming that gross capital formation in each sector had grown between 1947 and 1960 at the same rate as gross output in that sector. In other words, we have assumed that the relationship between investment (as composed of expenditures on new construction and producers' durable equipment and miscellaneous capital charges) and gross output has remained constant. To compute Ohio River Basin inventories for 1960, we first identified the definitional relationships between net inventory statistics in the 1947 national income accounts and the 1947 national interindustry table. This was done for major industry categories, such as the agricultural, manufacturing, wholesale and retail sectors. By adjusting the available 1960 national income inventory statistics for differences in national income and interindustry definitions, national control totals were derived. Then the Basin's percent share of these national totals could be determined.

Finally, inventory levels within the major industry sectors were distributed on the basis of distribution patterns obtained from the Annual Survey of Manufactures. (For details of the procedure, see Appendix E-5.)

(f) Net Trade. The net trade column of the Ohio River Basin input-output framework represents the net transactions of each producing sector within the region with purchasers or suppliers outside of the region, including shipments to or receipts from abroad. In broad terms, it represents the region's balance of trade, or the value of gross exports minus gross imports. Such values may be positive or negative, depending on whether an industry is on balance a net exporter or a net importer.

The measurement of a region's trade balance is beset by conceptual and empirical difficulties. The more "open" a region, the more difficult it becomes to give quantitative meaning to many of the sectoral trade items. Conceptually, a region's export-import relationship could be considered as one of the prime movers of its economy. This is particularly true of regions that are relatively "open," i.e., regions which depend in considerable measure on trade with other regions. But problems are encountered in quantifying the region's "openness."

A number of methods have been developed to determine the relative importance of a region's trade. Of these methods, the one most generally known is the location quotient technique. This technique identifies the regional importance of an industry (in output or employment terms) relative to its national importance. If the industry's representation is greater at the regional level than at the national level, then the industry is defined as a regional net exporter. Conversely, if the industry's regional representation is found to be less than its representation in the nation as a whole, the industry is defined as a net importer. Without discussing the limitations associated with this method, it can be stated that while this technique is adequate to identify the major importing and exporting sectors on a net basis, it does not provide a good indication of the net amount or value of goods exported and imported by an industry sector.

An alternative, but less frequently used, means of quantifying a region's trade with the outside, is to multiply regional gross input estimates by national input-output coefficients to derive row entries for intermediate outputs. These entries, together with independent estimates for the final demand columns (excluding trade) can then be subtracted from the total regional gross output to derive net trade residuals. This method presupposes, of course, that reasonably up-to-date national input-output coefficients are available and that national and regional interindustry linkages are approximately the same.

To avoid these restrictive pre-conditions, the base year trade values for the Ohio River Basin were determined by a method requiring somewhat less stringent assumptions. Our approach involved the following steps: (1) Computing a weighted consumption share for the Ohio River Basin of total national consumption of each industry's output; (2) Computing the Ohio River Basin share of total national output in a given industry sector; (3) Determining the difference between these two shares, and expressing this difference as a percentage of the regional industry's production share; (4) Multiplying this factor by the respective regional industry output values for 1960 to derive net export or net import values.

The resulting regional trade estimates were then slightly adjusted in the process of reconciling the sum of independently determined final demand sectors and the intermediate demand column with Ohio River Basin gross output levels. Overestimations or underestimations of net trade could be ascribed to biases in weighting consumption shares or to the fact that the region's participation in foreign trade was not explicitly determined. For this reason, we attempted to counteract any possible biases in our net trade computation by making adjustments in the process of reconciliation.

On balance, we believe that our regional net trade value estimates are the best that can be made with existing data deficiencies. It should be noted, moreover, that the export and import industries identified by this method did not differ from the results obtained by means of a location quotient analysis. In fact, the method consistently confirmed the results of independent location quotient analyses, and in addition enabled us to quantify net trade levels (see Appendix E-6).

(g) Reconciliation of the Column Entries. As previously explained, the sum of the separately computed intermediate column and the final demand sector totals must equal the gross output total in each of the 27 industry sectors. By the same token, the column totals must equal the gross output column total.

Since each column is independently determined, it is not unusual for the sum to differ slightly from the gross regional output computed for a particular industry sector. The discrepancy could be due to any number of factors; in this instance it has been ascribed to underestimations or overestimations of either the intermediate demand totals, the net trade totals, or both. The components in these two columns were therefore appropriately adjusted in each industry sector by making slight decreases or increases in the individual value entries until consistent results were obtained.

(h) Row Entries: Primary and Non-Primary Inputs. The row entries in Table IV-1 record the total primary and non-primary inputs of each of the 27 industry sectors and of government. Primary inputs of industry represent payments to factors of production and non-factor charges (i.e., transfer payments, etc.) against final product which each industry incurred during the base year in the process of producing its goods and services. Non-primary inputs, on the other hand, consist of an industry's payments to all other industries for goods and services purchased.

(1) Primary Inputs. Primary inputs are divided into two rows: (i) household income (i.e., total personal income accruing to individuals during the base year) and (ii) other charges against final product. Household or personal income entries, as finally computed, consist of industry wage and salary disbursements, other labor income (dividends, net interest, claim payments, contributions to private pension plans, royalties, etc.), proprietors' income, property income, and transfer payments exclusive of social security payments to government.

We derived the household income component originating in each major industry sector (i.e., agriculture, coal mining, other mining, construction, manufacturing, wholesale and retail trade, finance-insurance-real estate, transportation-communication-utilities, services, and government) for the Ohio River Basin states. Personal income originating in each major sector* was weighted by employment shares, representing that portion of a state's industry employment which lies within the Basin. By summing the results for all the Basin portions of the relevant states, we obtained total income originating in each major industry sector for the region as a whole.

Regional personal income originating in the manufacturing sector was then further distributed among the industries which make up the manufacturing sector on the basis of the percentage distribution of total Basin payrolls. The payroll figures were derived from weighted industry payroll data for the Ohio River Basin states, using the 1960 Annual Survey of Manufactures as our source.

The second component of primary inputs consists of four types of charges against final product: (i) depreciation and other capital consumption allowances (e.g., amortization); (ii) payments to federal, state, and local governments (e.g., social security payments to government, property taxes, etc.); (iii) retained earnings, i.e., undistributed profits; and (iv) unallocated charges against final product.

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*See U.S. Department of Commerce, Survey of Current Business, August 1963, pp. 10-14.

Unlike the household income component, this row could not be determined independently because of data inadequacies. A more indirect procedure had to be used. We began by updating the combined household and government row entries of the national 200-sector model for 1947 (aggregated into the major industry sectors, i.e., agriculture, coal mining, other mining, construction, manufacturing, transportation-communication-utilities, wholesale and retail trade, finance-insurance-real estate, and services) by an index of gross product originating for the period, 1947-1960, obtained from the Survey of Current Business (October 1962 and September 1963).* The updated national primary input estimates were then multiplied by the region's share of national output in each of the major industry sectors. Finally, the total primary inputs of the regional manufacturing sector were apportioned among individual manufacturing industries on the basis of the 1960 value added distribution in the manufacturing sector.

Since the primary input levels for each of the 27 industry sectors consist of payments to households and other charges against total output, and since the regional household income row has been computed separately, it is now possible to obtain the residual charges against total output by taking the difference between total primary input levels and payments to households.

(2) Non-Primary Inputs. The non-primary inputs of an industry sector consist of the total current account expenditures for the purchase of goods and services from all other industries. These goods and services may be raw materials, semi-manufactured goods, or miscellaneous services, depending on the industry's production requirements. They are non-primary inputs because they represent the output of another industry sector.

Since by definition total inputs and outputs must be equal for each sector of an input-output system, it is possible to obtain total non-primary or intermediate inputs for each industry sector simply by subtracting the previously derived primary inputs from the total gross output of that sector.**

*Gross product originating as defined in national income accounts is almost the same concept as industry payments to households and government in the national 1947 interindustry study.

**An alternative procedure would have been to estimate the input requirements of each of the 27 sectors from each of the other sectors per unit of its output (729 cell entries), multiply each column of input-output coefficients by each industry gross output total to obtain the non-primary input elements, and then sum each column to obtain total non-primary inputs. While conceptually acceptable under certain circumstances, this procedure did not appear suitable for this study primarily because of the lack of up-to-date regional input-output coefficients.

(i) Balancing the Column and the Row Entries. While total gross inputs must equal total gross outputs for each of the industry sectors of an input-output system, this need not be the case for the total inputs and outputs of each of the final demand sectors. It is only necessary that the sum of the inputs and outputs for all the final demand sectors be equal.

In Table IV-1, which presents an input-output framework for the Ohio River Basin, the demand columns (excluding the intermediate demand column) together represent the output equivalent of the primary input rows. Conceptually, this resembles the national income accounts where economic performance can be measured either on the output side (in Table IV-1, the final demand columns) or on the input side (in Table IV-1, the primary input rows). The sum of the primary input row totals ($44,590 million) is thus equal to the sum of all final demand column totals. It follows from this and from the fact that gross output must equal gross input that total intermediate demand ($51,102 million) must equal total non-primary inputs.

Operationally, it would have been fortuitous if the individually and independently derived final demand sector totals and the primary input row totals had agreed on the first try. In deriving the base year values for this study, we found that the sum of the final demand column totals exceeded the sum of the primary input totals. As the intermediate demand and final demand columns had already been reconciled, and in view of the fact that the derivation of household income was based on reasonably comprehensive and up-to-date data, it was decided to lower the values in the row showing charges against final product in order to achieve a balance. In this manner, the table was balanced by adjusting the component whose values had been derived by the most indirect method.

2. Derivation of Projection Parameters

The derivation of parameters which enable the model to project regional economic activities for the next 50 years is the second major step in the implementation of the framework presented in Chapter III.

In order to estimate these parameters, a variety of statistical sources had to be relied upon. Some of the information is in the form of data series describing behavior patterns (e.g., the relationship between consumption expenditures and income). Other data are sought to provide the basis for certain very restrictive assumptions (e.g., the fixed relationship between personal income and gross product originating in each industry sector). Ideally, the parameters should be derived from data pertaining specifically to the economy of the Ohio River Basin, since this is the economy whose performance the model is asked to project. In practice, much of the required data is not published on a regional basis, and it is therefore necessary to use selected national data to represent projected relationships. The use of national aggregates to approximate patterns

of regional relationships is justified, in our opinion, by the Basin economy's previously described structural similarity "in microcosm" to the nation's economy.

The description of projection parameter derivations which follows is closely related to the methodological framework set forth in Chapter III. The computation details are given in Appendix F.

(a) Intermediate Demand. In Chapter III, the intermediate demand for the products of each industry sector is expressed as:

$$X_{iN} = \bar{a}_{iN} + \sum_j a_{iN} a_{Nj} X_j$$

where

$$\sum_j a_{Nj} X_j = X_{NN}.$$

The right-hand side of this equation can be easily identified in working equation 35, Chapter III. Therefore, in order to project the intermediate demand total for each industrial sector, projection parameters $\bar{a}_{iN}$, a_{iN}, and a_{Nj} must be derived.

The last parameter, a_{Nj}, is simply the 1960 proportionality coefficient obtained by dividing the non-primary input total for each Basin industry by the industry's corresponding total gross inputs or gross ouputs (see Chapter III, New Procedure for Implementing Interindustry Flows). The assumption imposed by this coefficient is that the column sum of intermediate inputs is a fixed proportion of total input or output. An implicit allowance is thus made for possible input substitutions or for changes in individual input-output coefficients (a_{ij}).

Parameters $\bar{a}_{iN}$ and a_{iN}, in turn, fix the intercept and slope of the linear curve or function which relates an industry's intermediate demand total to total intermediate demand for all industry sectors. Expressed in equation form, this gives:

$$X_{iN} = \bar{a}_{iN} + a_{iN} X_{NN}$$

where:

X_{iN} = intermediate demand total for a given industry sector

X_{NN} = sum of all intermediate demand totals for all sectors.

To derive these two projection parameters for each of the 27 industry sectors, the values of X_{iN} and X_{NN} must be known for at least two data points. Since these are available only for the years 1947 and 1960, we can obtain the parameters by using the following formula:

$$a_{iN} = \frac{X_{iN}^{60} - X_{iN}^{47}}{X_{NN}^{60} - X_{NN}^{47}} \qquad (i = 1, 2, \ldots\ldots, 27)$$

$$\bar{a}_{iN} = X_{iN}^{60} - X_{NN}^{60} \cdot \frac{X_{iN}^{60} - X_{iN}^{47}}{X_{NN}^{60} - X_{NN}^{47}} \qquad (i = 1, 2, \ldots\ldots, 27)$$

where the exponents indicate the years 1947 and 1960.

As a check for consistency, the following additional constraints are imposed:

(1) $$\sum \bar{a}_{iN} = 0$$

(2) $$\sum a_{iN} = 1$$

This requires the sum of the intercept parameters to equal zero and the sum of the slope parameters to equal one. (See also Appendix F-1.)

(b) Household Consumption Expenditures. The derivation of projections for household consumption expenditures in the Ohio River Basin requires two basic steps: (1) projecting household consumption proportionality coefficients for each of the projection years (see Chapter III, equation 25), and (2) projecting total household consumption expenditures in the Ohio River Basin for each projection year. Household consumption expenditure breakdowns by industry sector are then obtained by multiplying the derived proportionality coefficients by the projected total consumption expenditures.

In deriving regional household consumption proportionality coefficients, we first projected future consumer expenditure patterns on the basis of national expenditure patterns established for 52 commodity or service expenditure groups. With the aid of a conversion table, these expenditure estimates were converted into consumption coefficients for 27 industry sectors (see Appendix F-2).

Symbolically, the procedure can be expressed as follows:

(i) $C_{ORB} = Y_{p\ ORB} \cdot \beta_{US} \cdot \alpha_{US}$ (from equations 26-3, 27-1, 27-2)

(ii) $Y_{p\ ORB} = \sum_j h_j Y_j + Y_{G_1} + Y_{G_2}$ (from equation 31)

(iii) $Y_{G_1} = p(Y_{p\ ORB}\ \gamma)$ (from equations 32, 33)

Substituting (iii) into (ii) and rewriting the resulting expression gives:

(iv) $Y_{p\ ORB} - p(Y_{p\ ORB}\ \gamma) = \sum_j h_j Y_j + Y_{G_2}$

or:

(iv-a) $Y_{p\ ORB}(1 - p\gamma) = \sum_j h_j Y_j + Y_{G_2}$

or:

(iv-b) $$Y_{p\ ORB} = \frac{\sum_j h_j Y_j + Y_{G_2}}{1 - p\gamma}$$

Since $Y_{j\ ORB} = (1 - a_{Nj})\ X_j$ (from equation 20)

then (iv-b) becomes:

(iv-c) $$Y_{p\ ORB} = \frac{\sum_j h_j (1-a_{Nj})\ X_j + Y_{G_2}}{1 - p\gamma}$$

We can, therefore, rewrite (i) above, as follows:

(v) $$C_{ORB} = \left[\frac{\sum_j h_j (1-a_{Nj})\ X_j + Y_{G_2}}{1 - p\gamma} \right] \cdot \beta_{US} \cdot \alpha_{US}$$

Applying to this expression the consumption proportionality coefficient (C_i) then yields the projected household consumption expenditures on the products of a given industry sector i:

(vi) $$C_{i\ ORB} = \left[\frac{\sum_j h_j (1-a_{Nj})\ X_j + Y_{G_2}}{1 - p\gamma^{70}} \right] \cdot \beta_{US} \cdot \alpha_{US} \cdot C_i$$

This last expression is easily identifiable in final working equation 35, Chapter III.

From these expressions it can be seen that the following projection parameters are still to be derived: h_j, $(1-a_{Nj})$, Y_{G_2}, p, γ, β_{US}, α_{US}.

1. Derivation of h_j:

As defined in equation 31, Chapter III, h_j measures household income as a proportion of gross product originating (GPO) in each industry. In the Ohio River Basin model, this proportion is held constant at the 1960 level. This imposes the assumption that a fixed proportion of projected gross product originating in each industry sector will accrue to households in the form of personal income.

2. Derivation of $(1-a_{Nj})$:

As previously defined (see equation 21), a_{Nj} is the proportionality coefficient for a given industry j ($j = 1, \ldots, 27$), and is derived by dividing an industry's total non-primary inputs by the corresponding industry's gross output total. Similarly, $1-a_{Nj}$ expresses the proportion of an industry's total inputs represented by primary inputs (see equation 20). Here again the primary input/total output relationship for each industry in 1960 is assumed to hold for the projection years.

3. Derivation of Y_{G_2}:

Y_{G_2} represents that amount of government defense expenditures in the region which accrues to households in the form of income. It is estimated that of total government defense expenditures in the Ohio River Basin in 1960, approximately 32 percent, or $862 million, consisted of payments to households, mostly in the form of salaries and wages. In the model we have assumed that this proportionality will be maintained during the projection period.

4. Derivation of p:

The parameter p is the household income proportionality coefficient for government nondefense expenditures. In other words, it represents the proportion of all government nondefense expenditures in the Ohio River Basin which flows to regional households in the form of income. In 1960, this proportion approximated 60%, and we have assumed that it, too, will remain at that level for the projection years.

5. Derivation of γ (gamma):

The parameter gamma (γ) defines the relationship between government nondefense expenditures and total personal income. Unlike the previously discussed parameters, γ is projected to change over time.

The changing values of γ are derived, first, by reconciling the projected government expenditure/personal income relationship for the year 2010, and then by interpolating between the values for 1960 and 2010 to obtain gammas for the intervening projection years.

6. Derivation of β_{US} (beta):

From equation 27-2, Chapter III, we have:

$$\beta_{US} = \frac{2.8057}{Y_{p\,US}} + .8380 - \frac{.7554t}{Y_{p\,US}}$$

(This follows directly from equations 25-1, 25-2, 26, and 27, the terms of which are explained in Chapter III.)

By substituting into the above equation projections of $Y_{p\,US}$,

where,

$$Y_{p\,US} = 5.9338 + .8083\ Y_{GNP} - .5050t$$

and where,

t = time (1929 = 0)

Y_{GNP} = projected Gross National Product in constant 1954 dollars

the projected parameter values for β_{US} are derived.

7. Derivation of α (alpha):

From equation 26-2, Chapter III, we see that:

$$\alpha_{US} = \left(\frac{10.2700}{Y_{d\,US}} + .8856 + \frac{.1444\,t}{Y_{d\,US}} \right)$$

(this follows from equations 25-1 and 26, and from the resulting equation 26-1).

By substituting into the equation projections of $Y_{d\,US}$ (total U.S. personal income derived from equation 27), parameter values for α_{US} can be obtained for each projection year.

(c) Government Expenditures. As previously pointed out, the Ohio River Basin model framework requires projections of both defense and nondefense expenditures of the federal government. While the level of regional nondefense expenditures is functionally related to the level of regional personal income (see equation below), the level of regional defense expenditures is independently or exogenously projected.

1. Derivation of Future Government Nondefense Expenditures in the Region. By letting G_1 represent total nondefense expenditures and g_i the share of total nondefense expenditures absorbed by each of the 27 industry sectors, we see that $G_{1_i} = G_1 \cdot g_i$, or the absolute amount of nondefense expenditures flowing to any one industry sector.

The determination of coefficient g_i has been explained in connection with the derivation of 1960 base year values. In addition, we have assumed that the 1960 values of g_i will remain fixed for the projection years.

From equation #33, Chapter III, the government nondefense expenditure/personal income relationship is defined as:

$$G_1 = \gamma \cdot Y_{p\ ORB}$$

Since regional total personal income ($Y_{p\ ORB}$) is also expressed by:

$$Y_{p\ ORB} = \frac{\sum_j h_j (1-a_{Nj}) X_j + Y_{G_2}}{1 - p\ \gamma}$$

we have in effect the relationship:

$$G_1 = \gamma \left(\frac{\sum_j h_j (1-a_{Nj}) X_j + Y_{G_2}}{1 - p\ \gamma} \right)$$

By multiplying this expression by g_i, we can represent government nondefense expenditures on the products of a given industry sector as follows;

$$G_{1_i} = g_i \cdot \gamma \left(\frac{\sum_j h_j (1-a_{Nj}) X_j + Y_{G_2}}{1 - p\ \gamma} \right)$$

The above expression thus states the amount of government nondefense expenditures flowing to each regional industry sector for a given year as a function of total nondefense expenditures in the region; these nondefense expenditures, in turn, are dependent upon the level of personal income in the region.

2. Derivation of Future Government Defense Expenditures in the Region. Projected levels of defense expenditures in the region are derived by a two-step process: first, defense expenditures are projected for the nation; second, a share of these expenditures is apportioned to the region.

At the national level, defense expenditures are projected on the assumption that the state of defense preparedness prevailing between 1950 and 1960 will continue into the future. Thus, although we anticipate a decline in the share of GNP expended to meet defense requirements, we nevertheless project an approximately 64 percent rise in the absolute level of national defense expenditures between 1960 and 1980, and a further doubling of the 1980 level by 2010.

In estimating future levels of defense expenditures in the Ohio River Basin, we have assumed that the region's share of national defense expenditures will increase from an estimated 6% in 1960 to approximately 10% in 1980 and that this share will remain stable thereafter. The rise in the region's share of national defense expenditures is intended to reflect the effect of an expected shift in the future distribution of national defense expenditures from regions now having a relatively high per capita incidence of such expenditures to regions now having a relatively low incidence.

(d) Investment. In the discussion of base year values, we explained that the investment column of the Ohio River Basin input-output framework represents expenditures for all new residential and nonresidential construction, new plant and equipment, miscellaneous charges to capital account, and net changes in inventories. These investment categories (see investment column in Table IV-1) were projected in four steps: (1) total investment (comprising all investment categories) was projected on the basis of projected rates of growth in national gross private domestic investment; (2) regional construction expenditures were projected on the basis of projected rates of growth in national private construction expenditures; (3) future levels of construction expenditures were subtracted from future levels of total investment; (4) the residual (i.e., all nonconstruction investment expenditures) was distributed among 26 industry sectors.

The distribution of expenditures among the 26 industry sectors follows the 1960 industry share breakdown and excludes sector 4 (construction) for which projections have already been determined (see Appendix F-4).

(e) Net Trade. In general, the net trade portion of an industry's total output is projected to grow at the same rate as the industry's total output. It should be emphasized, however, that in this model the growth of total output has a different meaning for the non-export industries (i.e., industries which are net importers or relatively small exporters) than for the so-called export industries.

For the non-export industries, the value of net trade for each industry sector is assumed to grow proportionately to the total output as determined by the model. This follows from the fact that the trade coefficient (e_i), which relates net trade to output for each of the non-export industries, is assumed to remain constant at the 1960 level. For the export industries, on the other hand, net trade is assumed to grow at the same rate as exogenously established output levels, i.e., levels determined independently of the model. These "independent" output projections were obtained primarily from separate industry studies which explicitly recognize and statistically analyze the direct relationship between the industry's growth in the nation and in the Basin. (For further details, see Appendix F-5.)

3. Computer Solution of the Model

To facilitate the computer solution of the model, the final working equation for each industry sector was rewritten in the more generalized form below:

$$\sum_{j=1}^{27} \left[a_{iN} a_{Nj} + \left(\frac{c_i^y \alpha_{US}^y \beta_{US}^y + g_i \gamma^y}{1 - p\gamma^y} \right) h_j (1 - a_{Nj}) + e_i + f_i \right] X_j^y + \bar{a}_{iN} + E_i^y + I_i^y + G_{2i}^y + \left(\frac{c_i^y \alpha_{US}^y \beta_{US}^y + g_i \gamma^y}{1 - p\gamma^y} \right) Y_{G_2}^y = 0$$

where $i = 1, 2, \ldots . 27$

$y = 1970, 1980, 1990, \ldots . 2010$

with the condition that:

$f_i = -1$ for $j = i$

$f_i = 0$ for $j \neq i$

and

$e_i = 0$ for $i = 2, 11, 14, 15, 17, 18,$ and 19

$E_i^y = 0$ for $i = 1, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 16, 20, 21, 22, 23, 24, 25, 26, 27$

In order to simplify the notation, we write A_{ij}^y for the expression within the brackets of the previous equation, and for the remaining terms of that equation,

we use the symbol K_i^y . Thus, we obtain:

$$A_{ij}^y = a_{iN}a_{Nj} + \left(\frac{c_i^y \alpha_{US}^y \beta_{US}^y + g_i \gamma^y}{1 - p\gamma^y} \right) h_j (1-a_{Nj}) + e_i + f_i$$

$$K_i^y = \bar{a}_{iN} + E_i^y + I_i^y + G_{2i}^y + \left(\frac{c_i^y \alpha_{US}^y \beta_{US}^y + g_i \gamma^y}{1 - p\gamma^y} \right) Y_{G_2}^y$$

or,

$$\sum_j A_{ij}^y X_j^y - K_i^y = 0 \qquad (i = 1, 2, \ldots\ldots, 27)$$

The computer solution of the model requires essentially three steps. First, the projection parameters and exogenous values for a given projection year are used as inputs in an IBM 1401 computer to derive the A and K values of the equations above, where A represents a square matrix of constant coefficients and K represents the sum of the exogenously determined values for each industry sector. Thus the system is of the form $AX = K$.

In the second step, the matrix thus derived is inverted and the simultaneous equation system solved by using the PN LAMI (Large Matrix Inversion with Accompanying Solution of Linear Equations) computer program. This program, which was obtained from the IBM Share Library, was developed by Sweden's Research Institute of National Defense. The program is coded in FORTRAN for the IBM 7090 computer. By inverting the matrix and solving the simultaneous equation system, it yields gross output projections for each industry sector.

In the third step, the gross output values that have been generated are used, together with appropriate projection parameters and exogenous values, to determine the value estimates of the various components of gross output for each industry sector (i.e., intermediate demand total, household consumption expenditures, net trade, etc.) as well as total personal income in the Ohio River Basin. This step is accomplished by using an IBM 1401 and applying a FORTRAN coded program.

4. Derivation of Employment and Labor Force Projections on the Demand Side

After the computer solution had yielded regional gross output projections for each of the 27 industry sectors, a series of additional steps were required

to translate these regional output projections into regional employment projections, and future employment levels into regional labor force projections. The following steps were involved:

(a) Adjustment of Output Levels for Computational Errors. In this step projected output levels were adjusted slightly downward (by approximately 3 percent) to take care of computational errors. These errors arose primarily from discrepancies between "computed" base year values and "actual" base year values. "Computed" values can vary from "actual" values depending on an equation's goodness of fit and on the degree of error introduced by rounding-off procedures.

(b) Derivation of Government Nondefense Outlays Flowing to Households. As previously explained, government nondefense expenditures are projected by relating them to personal income. A portion of these expenditures flows directly to households mainly in the form of salaries and wages and thus gives rise to employment. It is necessary, therefore, to project the level of government nondefense payments to households. This is accomplished by means of the equation

$$Y_{G_1} = p\, G_1$$

where:

Y_{G_1} = Government nondefense payments to households

p = A fixed proportionality coefficient derived from 1960 base year values

G_1 = Government nondefense expenditures

It will be recalled that G_1 in turn is a function of personal income (see Chapter III, equation 33).

(c) Derivation of Employment in 27 Industry Sectors and in the Government Nondefense Sector. With projected output volumes now established for 28 sectors (the 27 industry sectors plus the government nondefense sector) employment levels can be determined for them by dividing projected gross output volumes (for government, output equals expenditures) by projected productivity levels. Projected productivity levels are in turn derived from independent projections of historical relationships between output and employment (value added per employee) in industry sectors for the nation as a whole (see Appendix F-6).

Total employment is thus obtained for all 28 sectors simply by summing industry employment and government nondefense employment.

(d) Adjustments for Nonclassified Employment, Unemployment, and the Armed Forces. Since we used the Census of Population employment figures as our control totals (primarily for the purpose of facilitating subregional allocations), an additional adjustment was required to account for employment in the nonclassified category (sector 29)--a category used by the Census of Population to list all persons whose industry affiliation is not known. It was assumed that employment in this category will average 2.25% of projected total employment in the 28 sectors described above. This percentage is based on the average relationship for 1940-60.

By totalling employment for all 29 employment sectors and assuming an unemployment rate of 4.8 percent, we derived projections of the civilian labor force in the Ohio River Basin. The unemployment rate of 4.8 per cent is based on the assumption that the 1960 regional/national unemployment rate relationship is maintained, with national unemployment set at 4 percent of the civilian labor force throughout the projection period. (This latter assumption bears out the Corps of Engineers' stipulation of "a high level of national employment and activity.") As a final step, the projected number of persons in the armed forces in the region (see Appendix C) is added to the total civilian labor force to yield projections for the total Ohio River Basin labor force to the year 2010.

C. RECONCILIATION OF DEMOGRAPHIC AND DEMAND PROJECTIONS AND DERIVATION OF "EQUILIBRIUM" LABOR FORCE, EMPLOYMENT AND OUTPUT LEVELS

In Section A of this chapter, we described how projections of the total supply of labor in the Ohio River Basin were derived by means of a demographic projection method. In Section B we explained the operational procedures underlying the demand side projections of industry output, employment, and total labor force. In this final section, we shall state how these two sets of "preliminary" projections were reconciled to produce final or "equilibrium" projections.

As previously mentioned, we view the future level and structure of employment and output in the Ohio River Basin as the result of the interaction between the supply of labor, as determined by demographic forces at work in the region and the demand for labor, as determined by the region's economic development potentials. The final or "equilibrium" employment levels can thus be obtained simply by balancing supply against demand in terms of the labor force.

A consistency check on the over-all projection results is first carried out by a series of procedures already described in Chapter III. We had also stipulated in that Chapter that any "preliminary" projections would have to be rejected if the difference between the labor demand and labor supply projections exceeded 10 percent. In none of the projection years, however, did we encounter a discrepancy of that magnitude. In fact, the two sets of labor force projections reveal discrepancies ranging from plus 6.42% to minus 5.54%.

	Labor Force Demand Projections (in thousands)	Labor Force Supply Projections (in thousands)	Demand/Supply Projection Ratio	Discrepancy In (Percent)
1970	7,579.9	7,534.1	100.61	+ .61
1980	8,881.6	8,346.1	106.42	+6.42
1990	9,858.0	9,413.2	104.73	+4.73
2000	11,023.9	11,114.9	99.18	-1.82
2010	12,360.0	13,084.4	94.46	-5.54

Since the discrepancies between the two sets of projections were relatively small and since the output levels generated by the model for regional export industries approximated the range of independent output projections, the results were judged to be reasonably consistent and were therefore deemed acceptable. Reconciliation of the figures was then accomplished by averaging the total labor force supply and demand projections for each projection year. These averages were accepted as the "equilibrium" or final regional total labor force estimates.

All of the employment and output estimates were subsequently reconciled with the equilibrium labor force projections. This process was accomplished by deducting the projected number of persons in the armed forces within the region from our equilibrium total labor force estimates, and then making appropriate proportional reductions or increases in employment and output levels in each of the individual industry sectors, so as to reconcile all projections with the equilibrium labor force estimates. The resulting equilibrium employment and output levels were then used for the purpose of allocating economic activity among the 19 subareas of the region.

Our equilibrium labor force estimates were also used to derive equilibrium population projections. These new population estimates implied the following major alterations in our original demographic assumptions: (1) Implicit in the equilibrium population projection is the assumption that net outward

migration from the region will continue at the 1950-1960 rate during the period 1960-65, but will then decline sharply until 1975, beyond which the rate will remain stable until the year 2010. This assumption differs from that made in the original demographic projection where net outward migration was assumed to continue at the 1950-60 rate to 1965, but would decline gradually thereafter at the rate of 2.5 persons per thousand each five-year period, until out-migration reaches zero shortly after the year 2010. (2) Implicit in the equilibrium labor force projection is the assumption that the difference between Ohio River Basin labor force participation rates and national labor force participation rates will decrease sharply until 1980, and will then continue unchanged to the end of the projection period. This alters the original assumption which stated that the difference between the national and the Ohio River Basin labor force participation rates would be reduced at a constant rate until it reached zero shortly after 2010.

The major implication of the equilibrium projection, when compared to the demographic projection, is that economic conditions in the Ohio River Basin will show a relative improvement during the first twenty years of the projection period. Nevertheless, certain structural differences between the economy of the Ohio River Basin and the nation will continue thereafter, so that some net outward migration will take place and some differentials between Ohio River Basin and national labor force participation rates will exist to the end of the projection period.

CHAPTER V

SPECIAL STUDIES

A. POPULATION PROJECTIONS FOR SELECTED METROPOLITAN AREAS

The population of the following Standard Metropolitan Statistical Areas (SMSA's)--all located along the mainstem of the Ohio River--has been projected to the years 1980 and 2010, with the projections of the corresponding Ohio River Basin subareas serving as control figures:

Steubenville-Weirton	Subarea E -- Upper Ohio
Wheeling	Subarea E -- Upper Ohio
Huntington-Ashland	Subarea H -- Ohio-Huntington
Cincinnati	Subarea K -- Ohio-Cincinnati
Louisville	Subarea N -- Ohio-Louisville
Evansville	Subarea O -- Lower Ohio-Evansville

The projections shown in Table V-1 represent estimates of future population levels in these metropolitan areas as they were defined by the Bureau of the Budget prior to the Census of 1960.

The following tabulation gives the county delineations of each of the SMSA's along the mainstem of the Ohio River:

SMSA	Counties	
Steubenville-Weirton	Jefferson	(Ohio)
	Brooke	(W. Va.)
	Hancock	(W. Va.)
Wheeling	Ohio	(W. Va.)
	Marshall	(W. Va.)
	Belmont	(Ohio)

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SMSA	Counties	
Huntington-Ashland	Cabell	(W. Va.)
	Wayne	(W. Va.)
	Boyd	(Ky.)
	Lawrence	(Ohio)
Cincinnati	Hamilton	(Ohio)
	Campbell	(Ky.)
	Kenton	(Ky.)
Louisville	Jefferson	(Ky.)
	Clark	(Ind.)
	Floyd	(Ind.)
Evansville	Vanderburgh	(Ind.)
	Henderson	(Ky.)

In making our population projections, we have assumed that the geographical boundaries of these SMSA's will not be expanded between 1960 and 2010. This assumption is necessary, because we cannot anticipate the extent or the timing of future revisions in the definitions of these metropolitan areas. Since we expect the post-war trends toward suburbanization and further decentralization of urban activities to continue, it is likely that significant population increases will take place in the counties adjacent to the metropolitan areas as now defined, particularly in the decades after 1980.

The population projections shown in Table V-1 were developed as follows: (1) ratios of SMSA to subarea populations were computed for the census years, 1930-1960; (2) intercensal rates of population change in the SMSA's (within their 1960 definition) were studied for the past four decades, together with changes in population density and in levels of urbanization; (3) the history of in- or out-migration was traced for the period, 1940-1960, and net migration was computed as a percent of the total population enumerated at the beginning of each decade; (4) major changes in the employment mix were examined for the period, 1940-1960, and judgments were made regarding the direction of population growth within each SMSA on the basis of land-use and major highway construction plans; (5) finally, population projections prepared by local public agencies were taken into consideration wherever such information was available.

Table V-2 shows the ratios of SMSA to subarea populations for the projection years, 1980 and 2010. It will be noted that these ratios register decreases between 1980 and 2010 for 5 of the 6 metropolitan areas. In general,

TABLE V-1

POPULATION OF SELECTED OHIO RIVER METROPOLITAN AREAS, 1940 - 2010

SMSA[1]	1940[2]	1960[2]	1980	2010
Steubenville-Weirton	155,200	167,800	186,000	230,000
Wheeling	208,900	190,300	186,000	184,000
Huntington-Ashland	225,700	254,700	282,000	331,000
Cincinnati	787,000	1,071,600	1,347,000	1,642,000
Louisville	451,500	725,100	1,005,000	1,413,000
Evansville	157,800	199,300	259,000	333,000

1. As defined by Bureau of the Budget prior to Census of 1960
2. Actual census totals rounded to nearest 100 persons

Source: Census of Population and Arthur D. Little, Inc., projections for Ohio River Basin subareas.

TABLE V-2

POPULATION OF SELECTED OHIO RIVER METROPOLITAN AREAS AS PERCENT OF SUBAREA POPULATION, 1930 - 60 AND PROJECTED TO 1980 AND 2010

SMSA[1]	1930	1940	1950	1960	1980	2010
Steubenville-Weirton (Subarea E: Upper Ohio)	21.8	22.9	23.5	23.9	25	25
Wheeling (Subarea E: Upper Ohio)	31.9	30.8	29.2	27.2	25	20
Huntington-Ashland (Subarea H: Ohio-Huntington)	45.4	45.5	48.5	47.9	47	45
Cincinnati (Subarea K: Ohio - Cincinnati)	82.2	81.8	83.1	81.8	86	80
Louisville (Subarea N: Ohio - Louisville)	80.5	80.7	84.0	85.0	88	86
Evansville (Subarea O: Lower Ohio - Evansville)	28.0	29.3	34.7	35.6	37	35

1. As defined by Bureau of the Budget prior to Census of 1960

Source: Census of Population and Arthur D. Little, Inc., projections for Ohio River Basin subareas.

these decreases reflect the expected scatter of metropolitan populations beyond the counties now comprised within the definition of the SMSA's and also the probability of relatively more rapid population growth in the non-metropolitan sections of the Ohio River Valley, as industrial development occurs in the less densely settled parts of the flood plain and along major transportation arteries.

In conclusion, it is necessary to insert a cautionary note with regard to the predictive utility of the SMSA population projections. As mentioned earlier in the report, the smaller an area, the more susceptible it becomes to sudden changes in growth trends as a result of individual decisions by private entrepreneurs or adjustments in levels of public expenditures. Furthermore, it should be remembered that these projections are related to the subregional and regional economic projections for the Ohio River Basin and do not reflect the planning goals of local groups in the respective metropolitan areas.

B. URBAN/RURAL POPULATION PROJECTIONS

Projections of the rate of urbanization are hazardous because:

(a) Urbanization depends on two movements - rural-urban migration and urban-suburban redistribution - which are extremely sensitive to a variety of socio-economic factors.

(b) The census definition of "urban" was changed in 1950, thus hindering the identification of historical trends.

In order to determine how historical urban-rural ratios might be used in the light of the changing definition of what constitutes an urban population, the differences between the pre-1950 (i.e., the 'old' definition) and the 'new' definition were carefully examined. Basically, the 'old' and 'new' definitions can be represented by the following formulas:

$$P_{old} = I$$

$$P_{new} = I + U_o + (F - I_f)$$

where

P_{old} = the urban population according to the definition applied in 1940 and all previous censuses

P_{new} = the urban population according to the definition applied in 1950 and 1960

I = the population of incorporated places of 2500 or more persons

U_o = the population of unincorporated places of 2500 or more persons outside the urban fringe

F = the population of the urban fringe (population of the urban area surrounding a central city of at least 50,000 persons)

I_f = the population of incorporated places of 2500 or more persons within the urban fringe

A study of the population distribution in the areas that were added to the urban definition in 1950 revealed that the major numerical difference between 'old' and 'new' urban arises not from the inclusion of U_o, but rather from the inclusion of F, the urban fringe. Since the real growth of the urban fringe did not occur until after the arrival of the automobile, we felt justified in assuming that if the 'new' urban definition were applied to the population distribution of 1920 and earlier census years, it would result in approximately the same total urban population as was enumerated according to the 'old' definition.

With the comparable data points thus established, it became possible to fit a curve relating the level of urbanization to the country's population density over the period 1880-1960. This relationship, with a multiple correlation coefficient larger than 0.99, resulted in an excellent "fit" both for the contiguous United States and the Ohio River Basin. The establishment of a relationship between density and degree of urbanization made it possible to tie our projection of the urban population to the total population projection.

The above-described statistical method produced the following results:

CONTIGUOUS UNITED STATES

Years	Percent Urban	Population (Millions of Persons) Urban	Rural	Total
1880 old urban definition	28.2	14.1	36.0	50.2
1890 old urban definition	35.1	22.1	40.8	62.9
1900 old urban definition	39.7	30.2	45.8	76.0
1910 old urban definition	45.7	42.0	50.0	92.0
1920 old urban definition	51.2	54.2	51.6	105.7
1950 new urban definition	64.0	96.5	54.2	150.7
1960 new urban definition	69.9	124.7	53.8	178.5
1970 new urban definition	74.0	153.8	54.1	207.9
1980 new urban definition	77.0	188.5	56.3	244.8
1990 new urban definition	80.0	229.1	57.3	286.4
2000 new urban definition	82.0	271.1	59.5	330.6
2010 new urban definition	83.6	316.2	62.0	378.2

Sources: 1880-1960: U.S. Bureau of the Census, U.S. Census of Population: 1960, Vol. I, Table 3 (U.S. Summary).
1970-2010: Series III from Illustrative Projections of the United States by Age & Sex: 1960 to 1980, Series P-25, No. 187, November 1958, as revised by Arthur D. Little, Inc.

OHIO RIVER BASIN

Years	Percent Urban	Population (Millions of Persons) Urban	Rural	Total
1900 old urban definition	32.4	3.54	7.39	10.93
1910 old urban definition	38.8	4.81	7.60	12.41
1920 old urban definition	43.6	5.97	7.73	13.71
1950 new urban definition	52.7	9.16	8.22	17.38
1960 new urban definition	57.6	10.95	8.05	19.00
1970 new urban definition	60.0	12.34	8.23	20.57
1980 new urban definition	64.2	14.80	8.26	23.06
1990 new urban definition	67.3	17.37	8.44	25.81
2000 new urban definition	70.2	20.08	8.53	28.61
2010 new urban definition	72.8	23.00	8.60	31.60

Sources: 1900-1960: U.S. Bureau of the Census, Fourteenth Census of the United States: 1920, Volume I, Tables 49 and 50; U.S. Census of Population: 1950, Volume II, Table 5; U.S. Census of Population: 1960, Volume I, Table 6 (individual states). 1970-2010: Population projection for Ohio River Basin (see Chapter IV and Appendix D).

Subareas

As explained above, the past relationship between the urban percentage of the total population and population density was used in projecting the urban population of the Ohio River Basin. In the case of the subareas, the urban percentage as well as population density were computed for each subarea for 1950 and 1960. Future population density in each subarea likewise was computed on the basis of the projections of its population to 1980 and 2010. It was assumed that the urban percentage in each subarea would follow a curve that is similar to the curve describing the relationship between density and urban percentage in the Basin. The estimated urban percentage of the subarea's future population was then applied to its population projection to calculate the size of its future urban population (Table V-3).

An exception to this procedure was made for Subarea J, Guyandot-Big Sandy-Little Sandy, where the urban percentage of the population has been unusually small and declined further between 1950 and 1960. Although its total population has been projected to decline beyond 1960, it was thought unlikely that the urban percentage of the population could continue to decrease in a similar manner. It was considered more reasonable to hold this percentage constant, at its 1960 level.

Because of recent changes in the official Census definition of what constitutes the rural farm population, it has not been possible to determine a sufficient number of historical data points for a meaningful projection of the rural farm and rural nonfarm populations of the Ohio River Basin subareas. Besides, there is no clear-cut relationship between the rural farm population and persons engaged in agriculture. In April 1960, for example, of the six million employed persons in the newly defined U.S. farm population, only two-thirds were actually employed in agriculture.

C. HOUSEHOLDS IN THE OHIO RIVER BASIN

The number of households in the Ohio River Basin is projected to rise over the next half century at a somewhat higher rate than the population. This results from a projected decline in the average number of persons living in a household.* The following tabulation compares historical and projected declines in the average size of households in the nation as a whole and in the Ohio River Basin.

*By Census definition, a household includes all persons who occupy a housing unit, i.e., a house, an apartment or other group of rooms, or a room that constitutes separate living quarters. The occupants of a housing unit may vary from a family of two or more persons to a single individual.

	Number of Persons Per Household				
	Actual			Projected	
	1940	1950	1960	1980	2010
United States	3.78	3.52	3.38	3.36	3.25
Ohio River Basin	3.86	3.58	3.44	3.40	3.28

The anticipated shrinkage in the number of persons per household results from two assumptions concerning future socio-economic trends in the nation. One is the continued decline in the birth rate of both the U.S. and the Ohio River Basin (see explanation of demographic projection in Chapter IV), and the other is a postulated rise in the standard of living of the average American household, as measured by our projections of per capita income. Such an advance in income would enable more families to have their own separate dwelling, reduce the number of boarders in private households, and enable older children to leave their family and set up their own households before marriage.

Projection Method

The Bureau of the Census publishes national household projections to 1980. The Bureau's method is to apply age-sex-specific household status rates to the projected population classified according to sex and age. We applied the Bureau's *Series B household status rates** to our Ohio River Basin projections to 1980 of number of persons aged 15 and over, with the following results:

	Average number of persons, age 15 and over, per household		
	1960	1970	1980
United States (revised Series B)	2.37	2.36	2.35
Ohio River Basin	2.36	2.36	2.35

We assumed that the 1980 figure would remain constant to the year 2010, implying that the average number of persons of working age per household will have become stabilized by 1980. Then, by using projected Ohio River Basin birth rates, we found that the average number of persons of all ages per household would decline from 3.44 in 1960 to 3.28 in 2010. Thus, the average size of households in the Basin can be expected to remain somewhat larger than in the nation as a whole. A major cause of this disparity is the difference in levels of

*See Current Population Reports, Series P-20, No. 90, December 29, 1958, and slight revisions in Series P-20, No. 123, April 11, 1963.

TABLE V-3

URBAN POPULATION OF SUBAREAS OF THE OHIO RIVER BASIN

1960, 1980, AND 2010

Subarea	1960 Number (Thousands of Persons)	1960 Percentage of Total Subarea Population	1980 Number (Thousands of Persons)	1980 Percentage of Total Subarea Population*	2010 Number (Thousands of Persons)	2010 Percentage of Total Subarea Population*
A. Allegheny	316	39.2	430	46.7	691	58.0
B. Monongahela	181	32.5	196	32.3	297	40.6
C. Pittsburgh SMSA	1,967	81.8	2,196	83.0	2,776	85.4
D. Beaver	553	64.0	688	70.9	999	77.2
E. Upper Ohio	392	55.9	439	58.9	616	66.9
F. Muskingum	558	53.6	873	65.8	1,380	74.7
G. Kanawha - Little Kanawha	274	30.5	346	32.5	599	43.7
H. Ohio - Huntington	253	47.6	320	53.3	456	62.0
I. Scioto	805	72.3	1,253	80.3	2,036	85.9
J. Guyandot - Big Sandy - Little Sandy	38	8.2	33	8.2	30	8.2
K. Ohio - Cincinnati	1,035	79.0	1,304	83.3	1,773	86.4
L. Little Miami - Miami	978	68.9	1,395	76.7	2,175	82.3
M. Licking - Kentucky - Salt	248	34.2	301	35.3	654	52.8
N. Ohio - Louisville	637	74.7	928	81.3	1,407	85.7
O. Lower Ohio - Evansville	288	51.5	426	60.8	675	70.8
P. Green	102	25.9	119	26.2	290	42.7
Q. White	1,108	62.1	1,725	72.9	2,835	80.6
R. Wabash	676	49.7	1,056	60.8	1,810	72.1
S. Cumberland	542	44.5	777	50.7	1,501	65.2
Ohio River Basin Total	10,951	57.6	14,806	64.2	23,001	72.8

*Parts may not add to total as a result of error due to rounding.

urbanization between the Basin and the United States: the more urbanized an area, the larger the share of housing units occupied by unrelated individuals and small families.

Having projected household size, we computed the total number of Ohio River Basin households for 1980 and 2010 by dividing the projected number of persons per household into the projected population of the Basin.

For each of the 19 subareas, the number of households was projected by means of two computations: (1) a least squares equation relating the average number of persons per household in the given subarea to the average number of persons per household in the Basin in the census years, 1940, 1950, and 1960, and an extrapolation of these relationships to 1980 and 2010; (2) division of the resulting subarea household size into our projection of the subarea's population. A final step involved proportional adjustments of subarea household estimates in order to insure consistency with the projected number of Ohio River Basin households. The results of the subarea projections are shown in Table V-4. It can be seen that for most of the subareas the average size of household does not vary significantly from the Basin-wide average. Only in the most rural and economically disadvantaged areas (e.g., Subarea J--Guyandot-Big Sandy-Little Sandy) is the number of persons per household substantially higher than in the Basin as a whole.

D. NET GENERATION OF ELECTRIC POWER IN THE OHIO RIVER BASIN AND ITS SUBAREAS

Estimates of future electric power generation by government and investor-owned electric utilities in the Ohio River Basin and its subareas are given in Table V-5.

The figures for 1950 and 1960 were compiled from published information about steam and hydroelectric plants in the Ohio River Basin. We included one nuclear power plant, located in Shippingport, Pa. We did not include internal combustion plants because they accounted for less than one percent of total generating capacity in the ten Basin states.

At the present time, coal is by far the main source of energy for power plants in the Basin and the surrounding regions. The Basin produces approximately three-quarters of the country's coal, exporting most of it to electric power producers outside of the region. In 1960, about four-fifths of the Basin's coal was exported to other regions and only one-fifth was used within the Basin, primarily for electric power generation.

TABLE V-4

NUMBER OF HOUSEHOLDS AND AVERAGE NUMBER OF PERSONS PER HOUSEHOLD IN SUBAREAS OF THE OHIO RIVER BASIN, 1960 - 2010

Subarea	1960		1980		2010	
	Number in Thousands	Number per Household	Number in Thousands	Number per Household	Number in Thousands	Number per Household
A. Allegheny	233	3.45	272	3.39	370	3.22
B. Monongahela	162	3.42	179	3.39	229	3.19
C. Pittsburgh SMSA	709	3.39	794	3.34	1,021	3.18
D. Beaver	247	3.50	282	3.44	391	3.30
E. Upper Ohio	207	3.38	224	3.32	289	3.18
F. Muskingum	306	3.40	396	3.35	562	3.28
G. Kanawha - Little Kanawha	247	3.64	295	3.60	406	3.37
H. Ohio - Huntington	153	3.48	175	3.42	225	3.26
I. Scioto	325	3.42	462	3.38	715	3.31
J. Guyandot - Big Sandy - Little Sandy	112	4.15	97	4.13	93	3.93
K. Ohio - Cincinnati	394	3.32	479	3.27	636	3.22
L. Little Miami - Miami	412	3.44	532	3.41	783	3.37
M. Licking - Kentucky - Salt	199	3.64	235	3.62	357	3.46
N. Ohio - Louisville	246	3.46	333	3.43	487	3.37
O. Lower Ohio - Evansville	172	3.25	218	3.21	308	3.09
P. Green	109	3.59	128	3.56	198	3.44
Q. White	537	3.31	723	3.27	1,098	3.20
R. Wabash	418	3.25	541	3.21	798	3.14
S. Cumberland	336	3.63	425	3.61	668	3.44
Ohio River Basin Total	5,524	3.44	6,790	3.40	9,634	3.28

Source: Arthur D. Little, Inc., population projections

TABLE V-5

NET GENERATION OF ELECTRIC POWER IN THE OHIO RIVER BASIN AND ITS SUBAREAS: 1950, 1960, 1980 & 2010
(in millions of kilowatt-hours)

Subarea	1950	1960	1980	2010
A. Allegheny	703	2,943	31,271	134,906
B. Monongahela	1,010	3,197	24,383	175,863
C. Pittsburgh SMSA	7,588	10,458	28,025	97,326
D. Beaver	1,009	2,626	6,412	28,079
E. Upper Ohio	7,653	10,701	46,827	159,396
F. Muskingum	2,806	10,003	20,069	113,583
G. Kanawha - Little Kanawha	3,938	6,581	14,567	126,883
H. Ohio-Huntington	1,493	12,100	20,939	35,045
I. Scioto	600	147	119	1,478
J. Guyandot Big Sandy - Little Sandy	614	172	12,429	200,142
K. Ohio - Cincinnati	2,775	8,333	28,025	62,703
L. Little Miami - Miami	2,009	3,793	6,927	24,490
M. Licking - Kentucky - Salt	376	598	4,552	41,591
N. Ohio - Louisville	1,803	15,053	28,421	53,625
O. Lower Ohio-Evansville	1,697	21,548	42,750	194,442
P. Green	481	1,394	21,573	96,693
Q. White	2,093	3,749	9,698	108,938
R. Wabash	2,106	5,282	30,914	429,841
S. Cumberland	514	8,562	17,971	25,968
Total Ohio River Basin	41,268	127,240	395,831	2,111,203

Note: Subarea figures may not add up to Basin total due to rounding.

Our estimates of future levels of net generation are based on the assumption that the Basin will increasingly turn to exporting electric power in lieu of coal, as long-distance transmission from mine-mouth generating plants becomes more economical than the shipment of coal to steam plants outside of the Basin.

Were coal to continue to maintain its position as the major source of energy for electric power production in the eastern half of the United States, it might be possible to assume spectacular increases in net generation for export at mine-mouth plants in the Ohio River Basin. However, we must take into consideration the likely competition from nuclear power, as the cost of electricity from that source becomes competitive with conventionally produced power. In view of the current uncertainties regarding competitive cost relationships, we have assumed that nuclear power will make the greatest inroads on steam power in those areas which are remote from the coal fields and which consequently experience higher power costs than the markets within easy transmission distance of mine-mouth plants.

Our assumptions of steadily, yet not dramatically, rising levels of power exports from the Basin are quantified in Table V-6, which shows the estimated ratio of net generation to intraregional consumption growing from 1.11 in 1960 to 1.42 in 2010 (i.e., by 5% per decade). The ratio for 2010 means that 42% of the power produced in the Basin in that year will be transmitted to users outside of the Basin.

As Table V-6 indicates, total net generation in the Ohio River Basin for each projection year was calculated by multiplying our estimated generation/consumption ratio by our total consumption estimates. The regional power consumption estimates, in turn, are based on population levels, the industrial structure of the Basin and rates of power consumption of individual industry groups. Power consumption in the Basin is the sum of power consumption derived for each of the 19 subareas.

Subarea power consumption was computed in two steps: First we derived power consumed by manufacturing industries and, second, we derived power consumed by all other users of electricity.

(1) To derive power consumed by manufacturing industry in each subarea, we multiplied total subarea employment in each two-digit manufacturing category by estimates of state power consumption per employee in that SIC category. We used the state figure of power purchased per employee which appeared to reflect most accurately the power-use characteristics of the subarea's industry.

TABLE V-6

ESTIMATED RATIOS OF NET GENERATION TO ELECTRIC POWER CONSUMPTION IN THE OHIO RIVER BASIN, 1950 - 2010

	1950	1960	1970	1980	1990	2000	2010
a. Ratio of Generation to Consumption	1.09	1.11	1.17	1.22	1.28	1.35	1.42
b. Total Basin Power Consumption (in millions of kwh)	37,931	114,841	195,855	324,452	534,526	892,385	1,486,763
c. Total Basin Net Generation (in millions of kwh)	41,268	127,240	229,150	395,831	684,193	1,204,720	2,111,203

NOTE: For 1950 and 1960, a = c/b;
For projection years, c = a x b.

Source: Appendix J.

(2) To derive power consumed by all other users of electricity, we multiplied the subarea's population by relevant state per capita nonmanufacturing power purchases. Where a subarea cuts across state lines, we multiplied the portion of the subarea's population located in a particular state by that state's per capita nonmanufacturing power purchases.

The subarea consumption projections are based on the "equilibrium" population and employment projections derived from the Ohio River Basin model and on projected power consumption rates. Future per capita and per employee power usage was determined by extrapolating historical rates of increase.

After computing future power consumption and future levels of net generation for the Ohio River Basin as a whole, we allocated net generation to the 19 subareas in the following manner:

(1) We obtained figures on new and additional power generating capacity to be constructed by 1970 directly from the electric power producers in the region. By applying appropriate plant factors to existing and planned capacity, we computed net generation and its percentage distribution among the subareas for 1970.

(2) We then used the projected subarea distribution of coal production in 2010 (see Appendix I) as a first approximation of the likely distribution of power generation among the subareas in that year, thus incorporating our assumption about the future location of generating stations near mine sites. Although subareas K, L, and N do not have any known coal deposits, we assumed that these predominantly metropolitan subareas would continue to produce part of their own power needs. Accordingly, we estimated net generation in these three subareas by multiplying the subarea's generation/consumption ratio (based on historical trends) by our estimate of subarea consumption in the year 2010. Once these allocations to the three subareas were completed, we adjusted the "first approximation" distribution so that the sum of the subarea shares would add up to 100 percent.

(3) We obtained subarea shares for 1980, 1990, and 2000 by interpolating between the 1970 and 2010 distributions.

(4) Finally, we applied the subarea shares in each projection year to our projection of total Basin generation for that year in order to obtain the subarea net generation figure shown in Table V-5.

For a detailed discussion of the procedures described above, see Appendix J.

APPENDIX A

CRITERIA FOR DELINEATION OF OHIO RIVER BASIN SUBAREAS

The following criteria were used to delineate subareas of the Ohio River Basin.

A. CRITERIA DETERMINED BY BASIC DATA CONSIDERATIONS

1. Subarea boundaries will follow county lines.

   Counties constitute the basic building blocks for a historical analysis of census and other government data. For example, the Census Bureau water-use regions,* adopted for this study, are bounded by county lines that are nearest to the natural limits of the watershed.

2. Subareas will consist of contiguous county groupings.

   A non-contiguous aggregation of counties would violate the criterion of delineating subareas according to major watersheds tributary to the main stem of the Ohio River.

3. Multi-county Standard Metropolitan Statistical Areas (SMSAs) will not be divided among subareas.

   The Census Bureau provides more detailed economic and social data for SMSAs than for individual counties. Furthermore, an increasing number of public and private agencies publish data and analyses of economic and social changes in SMSAs. With further urbanization, SMSAs will assume ever increasing importance as reporting units in future census studies.

4. Serious imbalance in population distribution between subareas is to be avoided in the interest of projection reliability.

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*See U. S. Bureau of the Census: U. S. Census of Manufactures: 1958. Industrial water use, Subject report MC 58(1)-11. U. S. Government Printing Office, Washington, D. C., 1961.

The smaller the number and population of counties assigned to a subarea, the greater will be the unreliability of long-range projections. This criterion was applied to group two or more tributary watersheds within a single subarea.

B. CRITERIA BASED ON WATER USE AND DEVELOPMENT CONSIDERATIONS

1. Each major tributary watershed will form the nucleus of a subarea, other criteria permitting.

   A list of major tributary basins was developed by the Corps of Engineers in collaboration with Arthur D. Little, Inc.

2. Areas along the main stem of the Ohio have special problems and opportunities that warrant the delineation of essentially "riparian" subareas, other criteria permitting.

   A single tier of counties on each river bank forms the nucleus of "riparian" subareas. Additional counties qualify for inclusion if they are drained by minor tributaries of the Ohio or if they are directly influenced by physical and economic developments along the main stem.

C. CRITERIA BASED ON SOCIO-ECONOMIC CHARACTERISTICS OF REGIONAL HOMOGENEITY

An extensive data-collection program was undertaken to obtain a historical profile of each of 384 counties in the study area. The final allocation of counties to subareas was based on the following characteristics:

1. Rate of population change, 1930-60

2. Urban-rural distribution of population

3. Historical importance of manufacturing and employment "mix" in the local economy

4. Prosperity of agricultural sector, based on farm-operator family level-of-living index, 1954

5. Disposable personal income, as reported by states

To resolve the subarea allocation of marginal counties, the following sources were consulted:

1. Donald J. Bogue and Calvin L. Beale, Economic Areas of the United States, The Free Press of Glencoe, Glencoe, Illinois, 1961, whose criteria of regional socio-economic homogeneity are broadly based and have gained acceptance in publicly and privately sponsored regional studies.

2. Publications providing trade-area delineations (Rand McNally Commercial Atlas: Editor and Publisher Annual Market Guide; metropolitan planning studies)

By using the criteria and steps described above, the Ohio River Basin was divided into the 19 subareas listed below, together with their 1960 population:

	1960 Population (rounded)
A. Allegheny	805,100
B. Monongahela	556,100
C. Pittsburgh SMSA	2,405,400
D. Beaver	864,100
E. Upper Ohio	700,700
F. Muskingum	1,040,300
G. Kanawha-Little Kanawha	899,400
H. Ohio-Huntington	531,700
I. Scioto	1,113,400
J. Guyandot-Big Sandy-Little Sandy	463,700
K. Ohio-Cincinnati	1,309,600
L. Little Miami-Miami	1,419,000
M. Licking-Kentucky-Salt	722,700
N. Ohio-Louisville	852,600
O. Lower Ohio-Evansville	559,200
P. Green	393,100
Q. White	1,782,900
R. Wabash	1,362,400
S. Cumberland	1,219,200
	19,000,600

APPENDIX B

COUNTY COMPOSITION OF OHIO RIVER BASIN SUBAREAS

County	County Code*	State	Standard Metropolitan Statistical Area	SMSA Code*
		Subarea A--ALLEGHENY		
Armstrong	164	Pennsylvania		
Cambria	167	Pennsylvania	Johnstown	014
Clarion	168	Pennsylvania		
Crawford	169	Pennsylvania		
Elk	170	Pennsylvania		
Forest	172	Pennsylvania		
Indiana	174	Pennsylvania		
Jefferson	175	Pennsylvania		
McKean	177	Pennsylvania		
Somerset	179	Pennsylvania	Johnstown	014
Venango	180	Pennsylvania		
Warren	181	Pennsylvania		
		Subarea B--MONONGAHELA		
Barbour	324	West Virginia		
Fayette	171	Pennsylvania		
Garrett	384	Maryland		
Greene	173	Pennsylvania		
Harrison	336	West Virginia		
Lewis	339	West Virginia		
Marion	343	West Virginia		
Monongalia	348	West Virginia		
Preston	354	West Virginia		
Randolph	357	West Virginia		
Taylor	361	West Virginia		
Tucker	362	West Virginia		
Upshur	364	West Virginia		

*Code numbers are used to identify raw data collection cards and punch cards for each county of the Ohio River Basin.

County	County Code	State	Standard Metropolitan Statistical Area	SMSA Code
		Subarea C--PITTSBURGH SMSA		
Allegheny	163	Pennsylvania	Pittsburgh	015
Beaver	165	Pennsylvania	Pittsburgh	015
Washington	182	Pennsylvania	Pittsburgh	015
Westmoreland	183	Pennsylvania	Pittsburgh	015
		Subarea D--BEAVER		
Butler	166	Pennsylvania		
Lawrence	176	Pennsylvania		
Mahoning	137	Ohio	Youngstown-Warren	013
Mercer	178	Pennsylvania		
Trumbull	156	Ohio	Youngstown-Warren	013
		Subarea E--UPPER OHIO		
Athens	105	Ohio		
Belmont	106	Ohio	Wheeling	021
Brooke	327	West Virginia	Steubenville-Weirton	012
Columbiana	114	Ohio		
Doddridge	331	West Virginia		
Hancock	335	West Virginia	Steubenville-Weirton	012
Jefferson	131	Ohio	Steubenville-Weirton	012
Marshall	344	West Virginia	Wheeling	021
Monroe	141	Ohio		
Ohio	351	West Virginia	Wheeling	021
Pleasants	352	West Virginia		
Tyler	363	West Virginia		
Washington	161	Ohio		
Wetzel	367	West Virginia		
Wood	369	West Virginia		

County	County Code	State	Standard Metropolitan Statistical Area	SMSA Code
		Subarea F--MUSKINGUM		
Ashland	104	Ohio		
Carroll	109	Ohio		
Coshocton	115	Ohio		
Guernsey	123	Ohio		
Harrison	126	Ohio		
Holmes	129	Ohio		
Knox	132	Ohio		
Licking	134	Ohio		
Morgan	143	Ohio		
Muskingum	145	Ohio		
Noble	146	Ohio		
Perry	147	Ohio		
Richland	151	Ohio		
Stark	155	Ohio	Canton	006
Tuscarawas	157	Ohio		
Wayne	162	Ohio		
		Subarea G--KANAWHA-LITTLE KANAWHA		
Alleghany	381	North Carolina		
Ashe	382	North Carolina		
Bland	371	Virginia		
Boone	325	West Virginia		
Braxton	326	West Virginia		
Calhoun	329	West Virginia		
Carroll	373	Virginia		
Clay	330	West Virginia		
Fayette	332	West Virginia		
Floyd	375	Virginia		
Giles	376	Virginia		
Gilmer	333	West Virginia		
Grayson	377	Virginia		
Greenbrier	334	West Virginia		
Kanawha	338	West Virginia	Charleston	019

County	County Code	State	Standard Metropolitan Statistical Area	SMSA Code
Subarea G--KANAWHA-LITTLE KANAWHA (cont'd)				
Mercer	346	West Virginia		
Monroe	349	West Virginia		
Montgomery	378	Virginia		
Nicholas	350	West Virginia		
Pocahontas	353	West Virginia		
Pulaski	379	Virginia		
Putnam	355	West Virginia		
Raleigh	356	West Virginia		
Ritchie	358	West Virginia		
Roane	359	West Virginia		
Summers	360	West Virginia		
Watauga	383	North Carolina		
Webster	366	West Virginia		
Wirt	368	West Virginia		
Wythe	380	Virginia		
Subarea H--OHIO-HUNTINGTON				
Boyd	193	Kentucky	Huntington-Ashland	020
Cabell	328	West Virginia	Huntington-Ashland	020
Gallia	121	Ohio		
Greenup	224	Kentucky		
Jackson	130	Ohio		
Jackson	337	West Virginia		
Lawrence	133	Ohio	Huntington-Ashland	020
Lewis	246	Kentucky		
Mason	345	West Virginia		
Meigs	139	Ohio		
Pike	149	Ohio		
Scioto	153	Ohio		
Vinton	159	Ohio		
Wayne	365	West Virginia	Huntington-Ashland	020

County	County Code	State	Standard Metropolitan Statistical Area	SMSA Code
		Subarea I--SCIOTO		
Delaware	117	Ohio		
Fairfield	118	Ohio		
Fayette	119	Ohio		
Franklin	120	Ohio	Columbus	008
Hardin	125	Ohio		
Highland	127	Ohio		
Hocking	128	Ohio		
Madison	136	Ohio		
Marion	138	Ohio		
Morrow	144	Ohio		
Pickaway	148	Ohio		
Ross	152	Ohio		
Union	158	Ohio		
		Subarea J--GUYANDOT-BIG SANDY-LITTLE SANDY		
Buchanan	372	Virginia		
Carter	203	Kentucky		
Dickenson	374	Virginia		
Elliott	213	Kentucky		
Floyd	217	Kentucky		
Johnson	236	Kentucky		
Lawrence	242	Kentucky		
Lincoln	340	West Virginia		
Logan	341	West Virginia		
McDowell	342	West Virginia		
Martin	257	Kentucky		
Mingo	347	West Virginia		
Pike	275	Kentucky		
Wyoming	370	West Virginia		

County	County Code	State	Standard Metropolitan Statistical Area	SMSA Code
		Subarea K--OHIO-CINCINNATI		
Adams	103	Ohio		
Boone	191	Kentucky		
Bracken	195	Kentucky		
Brown	107	Ohio		
Campbell	201	Kentucky	Cincinnati	007
Clermont	112	Ohio		
Dearborn	038	Indiana		
Gallatin	219	Kentucky		
Hamilton	124	Ohio	Cincinnati	007
Kenton	237	Kentucky	Cincinnati	007
Mason	258	Kentucky		
Ohio	072	Indiana		
Ripley	082	Indiana		
Switzerland	088	Indiana		
		Subarea L--LITTLE MIAMI-MIAMI		
Butler	108	Ohio	Hamilton-Middletown	010
Champaign	110	Ohio		
Clark	111	Ohio	Springfield	011
Clinton	113	Ohio		
Darke	116	Ohio		
Fayette	042	Indiana		
Franklin	045	Indiana		
Greene	122	Ohio	Dayton	009
Logan	135	Ohio		
Miami	140	Ohio	Dayton	009
Montgomery	142	Ohio	Dayton	009
Preble	150	Ohio		
Shelby	145	Ohio		
Union	091	Indiana		
Warren	160	Ohio		
Wayne	099	Indiana		

County	County Code	State	Standard Metropolitan Statistical Area	SMSA Code
		Subarea M--LICKING-KENTUCKY-SALT		
Anderson	186	Kentucky		
Bath	189	Kentucky		
Bourbon	192	Kentucky		
Boyle	194	Kentucky		
Breathitt	196	Kentucky		
Clark	206	Kentucky		
Clay	207	Kentucky		
Estill	214	Kentucky		
Fayette	215	Kentucky	Lexington	016
Fleming	216	Kentucky		
Franklin	218	Kentucky		
Garrard	220	Kentucky		
Grant	221	Kentucky		
Harrison	228	Kentucky		
Henry	231	Kentucky		
Jessamine	235	Kentucky		
Knott	238	Kentucky		
Lee	243	Kentucky		
Leslie	244	Kentucky		
Letcher	245	Kentucky		
Lincoln	247	Kentucky		
Madison	254	Kentucky		
Magoffin	255	Kentucky		
Marion	256	Kentucky		
Menifee	260	Kentucky		
Mercer	261	Kentucky		
Montgomery	264	Kentucky		
Morgan	265	Kentucky		
Nelson	267	Kentucky		
Nicholas	268	Kentucky		
Owen	271	Kentucky		
Owsley	272	Kentucky		
Pendleton	273	Kentucky		
Perry	274	Kentucky		

County	County Code	State	Standard Metropolitan Statistical Area	SMSA Code
Subarea M--LICKING-KENTUCKY-SALT (cont'd)				
Powell	276	Kentucky		
Robertson	278	Kentucky		
Rowan	280	Kentucky		
Scott	282	Kentucky		
Shelby	283	Kentucky		
Spencer	285	Kentucky		
Washington	292	Kentucky		
Wolfe	296	Kentucky		
Woodford	297	Kentucky		
Subarea N--OHIO-LOUISVILLE				
Breckinridge	197	Kentucky		
Bullitt	198	Kentucky		
Carroll	202	Kentucky		
Clark	033	Indiana	Louisville	017
Crawford	036	Indiana		
Floyd	043	Indiana	Louisville	017
Harrison	052	Indiana		
Jefferson	059	Indiana		
Jefferson	234	Kentucky	Louisville	017
Meade	259	Kentucky		
Oldham	270	Kentucky		
Trimble	289	Kentucky		
Subarea O--LOWER OHIO-EVANSVILLE				
Ballard	187	Kentucky		
Caldwell	200	Kentucky		
Crittenden	209	Kentucky		
Daviess	211	Kentucky		
Gallatin	011	Illinois		
Hancock	225	Kentucky		
Hardin	013	Illinois		
Henderson	230	Kentucky	Evansville	002

County	County Code	State	Standard Metropolitan Statistical Area	SMSA Code
Subarea O--LOWER OHIO-EVANSVILLE (cont'd)				
Johnson	015	Illinois		
Livingston	248	Kentucky		
McCracken	251	Kentucky		
McLean	253	Kentucky		
Massac	017	Illinois		
Perry	076	Indiana		
Pope	018	Illinois		
Posey	078	Indiana		
Pulaski	019	Illinois		
Saline	021	Illinois		
Spencer	086	Indiana		
Union	290	Kentucky		
Vanderburgh	092	Indiana	Evansville	002
Warrick	097	Indiana		
Webster	294	Kentucky		
Subarea P--GREEN				
Adair	184	Kentucky		
Allen	185	Kentucky		
Barren	188	Kentucky		
Butler	199	Kentucky		
Casey	204	Kentucky		
Edmonson	212	Kentucky		
Grayson	222	Kentucky		
Green	223	Kentucky		
Hardin	226	Kentucky		
Hart	229	Kentucky		
Hopkins	232	Kentucky		
Larue	240	Kentucky		
Logan	249	Kentucky		
Metcalfe	262	Kentucky		
Muhlenberg	266	Kentucky		
Ohio	269	Kentucky		

County	County Code	State	Standard Metropolitan Statistical Area	SMSA Code
		Subarea P--GREEN (cont'd)		
Simpson	284	Kentucky		
Taylor	286	Kentucky		
Warren	291	Kentucky		
		Subarea Q--WHITE		
Bartholomew	026	Indiana		
Boone	029	Indiana		
Brown	030	Indiana		
Clay	034	Indiana		
Daviess	037	Indiana		
Decatur	039	Indiana		
Delaware	040	Indiana	Muncie	005
Dubois	041	Indiana		
Gibson	047	Indiana		
Greene	049	Indiana		
Hamilton	050	Indiana		
Hancock	051	Indiana		
Hendricks	053	Indiana		
Henry	054	Indiana		
Jackson	057	Indiana		
Jennings	060	Indiana		
Johnson	061	Indiana		
Knox	062	Indiana		
Lawrence	064	Indiana		
Madison	065	Indiana		
Marion	066	Indiana	Indianapolis	003
Martin	067	Indiana		
Monroe	069	Indiana		
Morgan	071	Indiana		
Orange	073	Indiana		
Owen	074	Indiana		
Pike	077	Indiana		
Putnam	080	Indiana		
Randolph	081	Indiana		

County	County Code	State	Standard Metropolitan Statistical Area	SMSA Code
		Subarea Q-WHITE (cont'd)		
Rush	083	Indiana		
Scott	084	Indiana		
Shelby	085	Indiana		
Washington	098	Indiana		
		Subarea R--WABASH		
Benton	027	Indiana		
Blackford	028	Indiana		
Carroll	031	Indiana		
Cass	032	Indiana		
Champaign	001	Illinois	Champaign-Urbana	001
Clark	002	Illinois		
Clay	003	Illinois		
Clinton	035	Indiana		
Coles	004	Illinois		
Crawford	005	Illinois		
Cumberland	006	Illinois		
Douglas	007	Illinois		
Edgar	008	Illinois		
Edwards	009	Illinois		
Effingham	010	Illinois		
Fountain	044	Indiana		
Fulton	046	Indiana		
Grant	048	Indiana		
Hamilton	012	Illinois		
Howard	055	Indiana		
Huntington	056	Indiana		
Jasper	014	Illinois		
Jay	058	Indiana		
Kosciusko	063	Indiana		
Lawrence	016	Illinois		
Miami	068	Indiana		
Montgomery	070	Indiana		

County	County Code	State	Standard Metropolitan Statistical Area	SMSA Code
		Subarea R--WABASH (cont'd)		
Parke	075	Indiana		
Pulaski	079	Indiana		
Richland	020	Illinois		
Sullivan	087	Indiana		
Tippecanoe	089	Indiana		
Tipton	090	Indiana		
Vermilion	022	Illinois		
Vermillion	093	Indiana		
Vigo	094	Indiana	Terre Haute	004
Wabash	023	Illinois		
Wabash	095	Indiana		
Warren	096	Indiana		
Wayne	024	Illinois		
Wells	100	Indiana		
White	025	Illinois		
White	101	Indiana		
Whitley	102	Indiana		
		Subarea S--CUMBERLAND		
Bell	190	Kentucky		
Cannon	298	Tennessee		
Cheatham	299	Tennessee		
Christian	205	Kentucky		
Clay	300	Tennessee		
Clinton	208	Kentucky		
Cumberland	210	Kentucky		
Davidson	301	Tennessee	Nashville	018
DeKalb	302	Tennessee		
Dickson	303	Tennessee		
Fentress	304	Tennessee		
Harlan	227	Kentucky		
Houston	305	Tennessee		
Jackson	233	Kentucky		

County	County Code	State	Standard Metropolitan Statistical Area	SMSA Code
		Subarea S--CUMBERLAND (cont'd)		
Jackson	306	Tennessee		
Knox	239	Kentucky		
Laurel	241	Kentucky		
Lyon	250	Kentucky		
McCreary	252	Kentucky		
Macon	307	Tennessee		
Monroe	263	Kentucky		
Montgomery	308	Tennessee		
Overton	309	Tennessee		
Pickett	310	Tennessee		
Pulaski	277	Kentucky		
Putnam	311	Tennessee		
Robertson	312	Tennessee		
Rockcastle	279	Kentucky		
Russell	281	Kentucky		
Rutherford	313	Tennessee		
Scott	314	Tennessee		
Smith	315	Tennessee		
Stewart	316	Tennessee		
Sumner	317	Tennessee		
Todd	287	Kentucky		
Trigg	288	Kentucky		
Trousdale	318	Tennessee		
Van Buren	319	Tennessee		
Warren	320	Tennessee		
Wayne	293	Kentucky		
White	321	Tennessee		
Whitley	295	Kentucky		
Williamson	322	Tennessee		
Wilson	323	Tennessee		

APPENDIX C

NATIONAL PROJECTIONS: GROSS NATIONAL PRODUCT AND ITS COMPONENTS

Summary

It is estimated that Gross National Product in 1954 prices* will reach nearly $2300 billion by 2010. The major assumption in this projection is that no major wars or depressions will occur in the intervening years and that high employment levels will prevail. Table I shows the actual figures for 1957, the last year of full employment, and the projections by decades, 1970 through 2010. The assumptions made and the methodology employed in arriving at the component projections are discussed individually below.

Population

Population is projected on the assumptions of Bureau of the Census "Series III," adjusted by Arthur D. Little, Inc., to agree with the 1960 Census of Population age and sex distribution for the 48 contiguous states. In Series III it is assumed that the birth rate will decline from the 1955-57 level to the 1949-51 level by 1965-70 and remain at this level to 1975-80; fertility is then assumed to decline further to the 1942-44 level by 1995-2000, at which level it remains until 2005 - 2010.**

Labor Force

The most important changes in future participation in the labor force are projected to occur among males in the age groups entering and leaving the labor force and among females in the middle age groups. With increased productivity and wealth, it is expected that a higher proportion of young men will continue their education longer and thus postpone their entry into the labor force. Also, the increasing complexity of production technology will make such increased training a necessity.

*1954 prices were used to preserve consistency with the historical series published by the U.S. Department of Commerce.

**For other assumptions and post-census adjustments see Bureau of the Census, Interim Revised Projections of the Population of the United States, by Age and Sex: 1965 and 1970, Series P-25, No. 241, January 1962; Interim Revised Projections of the Population of the United States, by Age and Sex: 1975 and 1980, Series P-25, No. 251, July 1962; Illustrative Projections of the Population of the United States, by Age and Sex: 1960 to 1980, Series P-25, No. 187, November 1958.

TABLE I

POPULATION, EMPLOYMENT AND GROSS NATIONAL PRODUCT
(FOR GENERAL GOVERNMENT, FARM AND PRIVATE NONAGRICULTURAL SECTORS OF THE ECONOMY),
CONTIGUOUS UNITED STATES, 1957 - 2010

	1957 Actual	1960 Actual	1970	1980	1990	2000	2010
			Millions of Persons				
Population--total	171.2	179.8	207.9	244.8	286.4	330.6	378.2
14 and over	122.0	126.7	149.9	175.4	205.2	242.0	280.4
Labor force	70.7	72.8	85.3	100.1	117.0	140.9	166.1
Participation rate	58.0%	51.3%	56.9%	57.0%	57.0%	58.2%	59.2%
Armed forces	2.8	2.5	2.3	2.2	2.1	2.0	2.0
Civilian labor force	67.9	70.3	83.0	97.9	115.0	138.9	164.1
Unemployment	2.9	3.9	3.3	3.9	4.6	5.6	6.6
Employed--total	65.0	66.4	79.7	94.0	110.4	133.3	157.6
General government	6.3	6.9	8.8	11.4	14.3	17.6	21.2
Farm	6.2	5.7	3.9	3.0	2.5	2.3	2.4
Private nonagricultural	52.5	53.8	67.0	79.6	93.6	113.4	134.0
			Billions of Dollars				
Gross National Product, 1954 prices	408.6	439.9	626.0	874.3	1202.8	1677.2	2271.2
Government	33.2	34.7	40.2	49.6	59.7	71.5	84.5
Farm	20.6	21.8	22.9	24.8	26.6	28.4	30.2
Private nonagricultural	354.8	383.4	562.9	799.9	1116.5	1577.3	2156.5

At the other end of the age structure, increases in savings and old-age insurance coverage are expected to allow somewhat earlier retirements from the labor force. Consequently, participation by males in the age groups 14-24 and 55 and over is projected over the next 50 years at gradually declining rates. Participation by males in the middle age groups, 25-54, is projected to remain at its high historical level.

Participation by females, age 14-19 and 65 and over, is projected to remain at its present level. It is felt that the trend toward earlier marriage and earlier childbearing and also toward increased education will keep participation by teenagers at its present level. At the other end of the age scale, it is expected that the downward influence of increased savings and insurance on participation by the older age groups will compensate the upward trend of women in the labor force so as to keep participation by women, age 65 and over, at its present low level. It is in the in-between ages that shifts in female participation are expected. It is projected that participation by females in these age groups will grow gradually over the next 50 years.

Future participation rates and the resulting age and sex distribution of future labor forces are shown in Table II. These are based on an examination of historical rates and the implications of the assumptions enumerated above.

It should be noted that the projections of labor participation rates to 1975 are those published by the Bureau of Labor Statistics in Special Labor Force Report No. 24, Interim Revised Projections of U.S. Labor Force, 1965-75, Table 2, page 4.

Armed Forces

The number of military personnel on active duty has been gradually falling since the end of the Korean hostilities. On the assumption of a peacetime economy and increasingly mechanized armed forces, the number of military personnel is projected to decline gradually to the year 2000, when it will start to level off at an average of about 2 million. This is equivalent to the participation rate for males, 15-59, in the armed forces dropping from 4.9% in 1960 to 3.2% by 1980 to 1.7% in 2010. This final rate is higher than the pre-World War II level of just under 1%; however, it implies a continuation of some form of compulsory peacetime service requirement for young men.

TABLE II

RATES OF PARTICIPATION AND NUMBER OF PERSONS IN THE U. S. LABOR FORCE

A. Percentage of the Population, Age 14 Years and Over, Participating in the Labor Force

	1957 Actual[1]	1970[2]	1980[3]	1990[3]	2000[3]	2010[3]
Male						
14 to 19 years	49.0	44.5	44.0	43.3	42.8	42.5
20 to 24 years	88.6	86.1	85.1	84.6	84.0	83.4
25 to 34 years	95.9	96.2	95.9	95.4	95.3	95.2
35 to 44 years	96.7	96.7	96.7	96.7	96.7	96.7
45 to 54 years	94.9	94.8	94.8	94.8	94.8	94.8
55 to 64 years	85.9	85.2	84.7	83.8	83.2	82.8
65 years and over	36.6	26.4	24.5	23.3	22.5	22.0
Female						
14 to 19 years	30.3	29.5	29.5	29.5	29.5	29.5
20 to 24 years	45.9	46.5	46.6	46.8	46.8	46.8
25 to 34 years	35.4	37.5	38.5	39.3	39.9	40.4
35 to 44 years	43.0	47.0	48.8	50.3	51.5	52.5
45 to 54 years	46.1	54.5	57.5	59.6	60.2	62.5
55 to 64 years	34.1	41.9	43.0	44.0	44.7	45.5
65 years and over	10.2	10.5	10.5	10.5	10.5	10.5

TABLE II (Continued)

B. Number of Persons in the Labor Force (in millions)

	1957 Actual[4]	1970[3]	1980[3]	1990[3]	2000[3]	2010[3]
Male						
14 to 19 years	3.7	5.2	5.5	6.7	7.7	8.3
20 to 24 years	4.8	7.4	9.1	9.3	12.0	12.9
25 to 34 years	11.2	11.9	17.4	20.2	22.6	27.8
35 to 44 years	11.0	10.9	12.0	17.5	20.4	22.8
45 to 54 years	9.2	10.8	10.4	11.4	16.6	19.3
55 to 64 years	6.2	7.6	8.5	8.2	9.1	13.0
65 years and over	2.5	2.3	2.5	2.9	3.0	3.1
Total	48.6	56.0	65.5	76.2	91.3	107.2
Female						
14 to 19 years	2.2	3.3	3.6	4.4	5.1	5.5
20 to 24 years	2.5	3.9	4.9	5.0	6.5	7.0
25 to 34 years	4.3	4.7	7.0	8.2	9.3	11.5
35 to 44 years	5.1	5.5	6.2	9.1	10.8	12.2
45 to 54 years	4.6	6.6	6.6	7.5	10.8	12.9
55 to 64 years	2.6	4.1	4.9	4.8	5.3	7.7
65 years and over	0.8	1.2	1.5	1.8	1.9	2.0
Total	22.1	29.3	34.6	40.8	49.7	58.9

1. Computed from data appearing in Special Labor Force Report No. 14, Bureau of Labor Statistics, and Current Population Reports, Bureau of the Census.
2. Special Labor Force Report No. 24, Interim Revised Projections of U. S. Labor Force, 1965-75, Bureau of Labor Statistics.
3. Arthur D. Little, Inc., estimates.
4. Special Labor Force Report No. 14, Table B-1, page A-13, Bureau of Labor Statistics.

Total Employment

The civilian labor force is the residual after subtracting the armed forces from the total labor force. It is projected that the unemployed will not exceed 4% of the civilian labor force, or, in other words, that essentially full employment will prevail.

Government Employment and Gross Product

General government employment excludes employment in government enterprises such as the post office and power companies which, it is considered, maintain themselves. Employment in such enterprises is included with the appropriate private industry sector.

It was assumed that growth in general government employment is related to growth in population, for this reflects an actual trend. Excluding the depression and war years, general government employment has followed a gently curvilinear relationship to population, increasing at a faster though gradually declining rate relative to the rate of increase in population. This relationship was extrapolated and estimates of future government employment were made on the basis of assumed future population sizes.

The assumptions regarding the future size of the armed forces have been explained above.

Gross government product is that arising from the functions of general government and the armed forces. When government product was graphed against the sum of general government and full-time military employment, it was found that, aside from the depression years, the two series had increased proportionately to each other. It was assumed that this relationship would continue in the future, and gross government product was therefore projected on the basis of the projected levels of general government employment and size of the armed forces.

Farm Employment and Gross Product

It is estimated that U.S. agricultural employment will decline from 5.7 million persons in 1960 to about 2.4 million persons in 2010. The following assumptions were made:

1. Population will grow as projected by U.S. Bureau of the Census Series III, adjusted to take into account the tabulations of the 1960 census. Series III results in a population of 244.8 million persons by 1980 and 378.2 million by 2010.

2. On an index basis of 1956 = 100, per capita domestic utilization of farm products will increase to 109 by 1975, at which level it will remain until 2010. This means in effect that as incomes rise, increases in the per capita demand for food will taper off and further additions to income will be spent instead on increased consumption of non-food items.

3. On an index basis of 1956 = 100, total export demand for farm products will increase at a constant rate to 120 by 1980, and 152 by 2010. This means the increase in foreign demand for U.S. farm products will be slightly larger each year as the foreign economies expand.

4. Real agricultural product per man-hour will continue to grow but at a decreasing rate. On the basis of 1947-49 = 100, real product per man-hour reached 192 in 1960 and will increase to 470 by 1980 and to 840 by 2010.

5. Average weekly hours per employee in agriculture will continue to fall so that by 2010 they will be only a little higher than the non-agricultural work-week. It is assumed that average weekly hours will drop to 40.1 in 1980 and to 35.0 in 2010.

6. As farm output increases over the years, farmers' purchases and use of "non-farm" products will continue to contribute an increasing share to total output. In 1960, farm gross product accounted for 55.6% of total farm output. It is estimated that by 1980 it will account for 47.0% and by 2010 only 37.9%.

Method

The first step was to estimate future demand for farm output. To obtain future domestic utilization, the projected increase in per capita utilization of domestic farm products was multiplied by the projected increase in population. This resulted in total domestic utilization growing from 100 in 1956 to 159 in 1980 to 245 in 2010. As stated above, the export level was assumed to grow from 100 in 1956 to 120 in 1980 to 152 by 2010. Domestic demand was combined with export demand at their 1956 weights, domestic utilization accounting for 84.3% and exports for 15.7%. This resulted in total demand for output of farm products growing from 100 in 1956 to 161 in 1980 to 275 in 2010.

Gross product arising in agriculture was related to total farm output by the least squares method. A correlation coefficient of 0.91 was obtained for an equation of the form, $\log y = a + b \log x$, where total farm output was the independent variable, x, and gross farm product, the dependent variable, y. Assuming total demand for agricultural products would equal total farm output,

it was estimated that gross product arising in agriculture would grow from $21.8 billion (1954 prices) in 1960 to $24.8 billion in 1980 and to $30.2 billion by 2010.

The next step was to estimate future gross product per worker. As stated above, agricultural gross product per man-hour on the basis of 1947-49 = 100 was projected to grow to 470 by 1980 and 840 by 2010. Real agricultural product per man-hour (at 1954 prices) averaged $0.84 in 1947-49. Multiplying this by the projected levels of output resulted in real agricultural product per man-hour of $3.95 in 1980 and $7.06 by 2010. If average weekly hours in agriculture fall from 45.5 in 1960 to 40.1 in 1980 and 35.0 in 2010, average annual hours per worker will fall from 2340 in 1960 to 2085 in 1980 and 1820 in 2010. These estimates of future annual hours were multiplied by the corresponding estimates of future real agricultural product per man-hour. The rising trend in real agricultural product per man-hour more than compensates the decrease in average annual hours worked. Thus, average real agricultural product per employee is projected to grow from $3775 in 1960 to $8232 in 1980 to $12,842 by 2010.

Implications of these Projections

1. Real agricultural product per man-hour, which increased at the average rate of nearly 2.4% per year between 1910 and 1960 and at the average annual rate of 4.2% per year between 1939 and 1960, is projected to increase at an average rate of 3.0% per year during the 50 years ending 2010. However, during the decade of the Sixties, the average annual rate will be 5.1%, about the same as that achieved during the Fifties. Thereafter, the annual rate of growth in real agricultural product per man-hour will gradually slow down so that it will average only 1.0% during the last decade, 2000 to 2010.

2. Employment in agriculture will decline to about 41% of its 1960 level by 2010. By way of comparison, during the 50 years ending 1960, it declined to about 51% of its 1910 level. However, during the last decade of the projection period, 2000 to 2010, increased demand for farm output will outdistance increased real product per employee, and employment will begin to rise again.

Private Nonagricultural Employment and Gross Product

In this projection, private nonagricultural employment was estimated as the balance remaining after employment in general government and on farms had been removed from estimated total employment. Employment in agriculture was estimated as the number needed to feed the projected population.

Employment in government likewise was related to the projected population. Private nonagricultural employment was estimated as the residual.

The last step was to estimate the gross product likely to be produced given the level of private nonagricultural employment. Average weekly hours were projected to fall from about 40 in 1957 to 32.5 by 2010, which implies an average annual rate of decrease approximating the historical rate of decrease of 0.4% per year. Multiplying projected employment times projected weekly man-hours times 52 weeks gave projections for total annual man-hours of labor in the private nonagricultural sector. It remained to estimate future productivity per man-hour in this sector and thus future gross product.

In Bureau of Labor Statistics Bulletin No. 1249, Trends in Output per Man-Hour in the Private Economy, 1909-1958, historical real product per man-hour in the nonagricultural sector of the private economy was computed on an index basis, 1947-1949 = 100, for the period 1909-1958. This index was graphed on semi-logarithmic paper and the resulting trend examined. An extrapolation of the long-run trend would give an increase in productivity over the next 50 years at a far greater rate than that achieved over the past 50. It was decided, therefore, to project productivity as increasing but at a very gradually declining rate. This results in the index of real product per man-hour reaching 385 by 2010 and implies an average annual rate of increase in real product per man-hour a little greater than 2.1%. The long-run historical rate of increase averaged a little less than 1.9% due to periods of no increase.

This index of real product per man-hour was converted to dollars at 1954 prices and multiplied by projected total annual man-hours. The resulting level of gross product for 2010 was $2156.5 billion.

Growth Rate Implications of the GNP Projections

The projection of Gross National Product to 2010 implies an average annual growth rate of 3.3%. Over the 53-year period the increase in real product per man-hour will account for the larger part of the increase in Gross National Product. The labor input will grow at a somewhat slower annual rate than the labor force due to the gradual decline in hours of work.

Estimates of the average annual rates of growth are shown on the following page.

Average Annual Percentage Rates of Growth

	Labor Force	Labor Input	Real Product per Man-Hour	GNP
1980/1957	1.5	0.8	2.5	3.4
2010/1980	1.7	1.3	1.9	3.2
2010/1957	1.6	1.1	2.2	3.3

A comparison with rates projected by other organizations (Table III) shows that the Arthur D. Little, Inc., rates represent a middle-ground estimate of Gross National Product growth rates. It should be noted that in the Arthur D. Little, Inc., projections, the labor force is represented as growing at a rate comparable to the historical experience in the United States between 1900 and 1960.

Detailed GNP Component Projections

Growth estimates of GNP components, such as major types of products and purchases, can be used as independent variables to gauge the national growth of several Ohio River Basin export industries. Furthermore, the relationships established between personal income and disposable income and between disposable income and household consumption expenditures at the national level (see equations in Table VI) can be used to estimate disposable income and household consumption expenditures in the Ohio River Basin for a given growth rate in personal income in the Basin.

The application of parameters derived from national data to determine regional relationships is an expedient made necessary by the lack of regional data. However, in view of the fact that the Ohio River Basin constitutes approximately one-tenth of the U.S., in terms of population and employment, and that in many aspects its economy represents a microcosm of the U.S. economy, one would not expect to find major differences between regional and national relationships.

TABLE III

AVERAGE ANNUAL GROSS NATIONAL PRODUCT GROWTH RATES, VARIOUS SOURCES

Sources	Entire Period		Subperiod	
	Years	% Per Year	Years	% Per Year
1. NPA	1955/57 - 2000	3.5	1955/57 - 1976	4.20
			1976 - 2000	2.90
2. BDSA	1959 - 2000	2.94	1959 - 1980	3.00
			1980 - 2000	2.81
3. RFF*	1958 - 2000	3.80	1958 - 1980	3.87
			1980 - 2000	3.70
4. Denison	1960 - 1980	3.33	----	----
5. JEC	1959 - 1975	5.2		
	1959 - 1975	4.7	----	----
	1959 - 1975	4.2		
6. SRI	1955 - 1975	3.4	1960 - 1965	3.5
			1965 - 1970	3.7
			1970 - 1975	3.6
7. U.S. Dept. Labor	1955 - 1970	3.5	1960 - 1965	3.4
			1965 - 1970	4.1
8. NPA	1955/57 - 1970	4.2	1955/57 - 1965	4.0
			1965 - 1970	4.6
9. Fortune	1959 - 1970	4.2	1960 - 1965	4.2
			1965 - 1970	4.2
10. OBE	1957 - 2010	3.1 approx.		

*Median projection

TABLE III (Continued)

Sources:

1. National Planning Association studies for the Outdoor Recreation Resources Review Commission, 1961.

2. "Water Resources Activities in the United States," Select Committee on National Water Resources, U.S. Senate, 86th Congress, 1960, Committee Print No. 8; projections prepared by Business and Defense Services Administration.

3. "Water Resources Activities in the United States," Select Committee on National Water Resources, U.S. Senate, 86th Congress, 1960, Committee Print No. 8; projections prepared by Resources for the Future, Inc.

4. The Sources of Economic Growth in the U.S. and the Alternatives Before Us, E. F. Denison--Committee for Economic Development, January 1962.

5. The Potential Economic Growth in the U.S., James W. Knowles--Joint Economic Committee, Study Paper No. 20, 1960.

6. Production Trends in the U.S. through 1975, Bennar Brown and M. Janet Hansen--Stanford Research Institute, March 1959.

7. "Manpower--Challenge of the 1960's," Bureau of Labor Statistics, 1960.

8. Long-Range Projections for Economic Growth: The American Economy--1970, National Planning Association, Planning Pamphlet No. 107, October 1959.

9. "The Market of the Sixties," Fortune Magazine, 1959.

10. Economic Base Survey of the Potomac River Service Area, Office of Business Economics, U.S. Department of Commerce, 1961.

Derivation of Components

Table IV provides historical and projected values for various GNP components, based upon a rate of growth of GNP of 3.4% between 1957 and 1980, and 3.2% between 1980 and 2010, or an average of 3.3% from 1957 to 2010. Table V shows the percentage distribution of these GNP components. The following steps were involved:

1. Regression analysis of constant dollar time series data.

2. Judgmental extrapolations and allocations.

3. Comparisons with results published by others--notably the projection studies of the National Planning Association and the recent Resources for the Future, Inc. projections to the year 2000.*

4. Testing of implications of parameters with indicated GNP growth rates.

Table VI lists the regression equations and indicates the time series data used to obtain them. The GNP components were derived as follows:

1. Personal income was assumed to grow at the same rate as GNP. This assumption is used in a number of government studies and is virtually verified in equation 1, Table VI.

2. Relationship parameters were derived by regressing personal disposable income against personal (pre-tax) income using data for the years 1929-1960 (excluding the war and immediate post-war years, 1940-1946).

3. Future taxes were estimated by subtracting projected disposable income from projected personal income.

4. Government expenditures as a percentage of GNP were projected to increase at the rate at which taxes as a percentage of GNP are projected to increase.

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*H. H. Landsberg, W. Fishman & J. Fisher, Resources in America's Future (Johns Hopkins Press, Baltimore, 1963); National Planning Association, Study Report No. 23 to the Outdoor Recreation Resources Review Commission, (Washington, D. C., 1962).

5. The volume of net exports relative to GNP was assumed to increase at the rate shown in the Resources for the Future projections.

6. Gross private domestic investment was derived as a residual, i.e., total GNP minus consumer expenditures, government expenditures, and net exports.

7. Government expenditures on durables, nondurables, services, and construction were regressed against total government expenditures; consumer expenditures on durables, nondurables, and services were regressed against total consumption expenditures. In both cases, time series data for the years 1947-1960 were used.

8. Total construction expenditures as a percent of GNP were assumed to remain at approximately the 1957-1962 level.

9. Private construction expenditures were derived as the residual of government construction expenditures minus total construction expenditures.

10. Producers' durables expenditures as a percent of GNP were held constant at full employment year levels. Producers' durables constitute a rather constant fraction of GNP over the long term.

11. Adding private construction and producers' durables expenditures and subtracting this total from gross private domestic investment provides net changes in inventories as a residual. Total changes in inventories and net exports were allocated among the various subcategories, i.e., durables, nondurables and services, on the basis of Resources for the Future allocations; they are shown as combined totals under these subgroups.

TABLE

REAL GROSS NATIONAL PRODUCT BY MAJO
(GNP in Billions of $

	1929	1947	1948	1949	1950	1951	1952	1953	1954	
Gross National Product	181.8	282.3	293.1	292.7	318.1	341.8	353.5	369.0	363.1	3
Durable Goods	30.8	55.8	55.4	51.9	65.3	74.6	75.1	80.8	71.6	
Personal consumption expenditures	14.9	23.3	24.6	26.3	32.1	29.2	28.5	33.1	32.4	
Producers' durable equipment	11.1	21.7	22.8	19.8	21.3	22.0	21.8	22.5	20.8	
Government purchases	.7	3.6	4.4	5.3	5.6	13.3	20.9	21.8	17.7	
Net exports	1.5	5.7	2.8	2.8	2.1	3.0	2.7	2.4	3.2	
Change in business inventories	2.6	1.5	.8	-2.4	4.3	7.1	1.2	1.0	-2.5	
Nondurable Goods	64.7	107.5	112.3	110.5	112.3	117.1	121.8	126.9	125.9	1
Personal consumption expenditures	65.3	105.3	105.1	106.3	109.2	111.2	115.0	118.3	119.3	1
Government purchases	1.1	2.3	4.8	6.0	2.4	3.9	6.2	10.8	6.6	
Net exports	-2.1	1.5	-1.0	-.6	-2.2	-.6	-.9	-1.8	-.9	
Change in business inventories	.4	-1.6	3.5	-1.2	2.9	2.6	1.5	-.5	.9	
Services	60.3	94.7	97.2	100.7	105.0	114.2	119.8	122.5	124.1	1
Personal consumption expenditures	48.0	67.0	69.6	71.7	75.5	78.2	80.8	83.7	86.3	
Government purchases	11.5	26.9	27.4	28.5	29.1	36.2	39.7	40.4	39.0	
Net exports	.8	.8	.2	.4	.4	-.2	-.6	-1.6	-1.3	
Construction	26.1	24.3	28.2	29.7	35.4	36.0	36.9	38.8	41.6	
Private construction	20.9	19.9	22.7	22.3	27.4	26.0	26.0	27.6	29.7	
Government construction	5.2	4.4	5.5	7.3	8.0	9.9	10.9	11.2	11.9	
Personal Consumption Expenditures	128.1	195.6	199.3	204.3	216.8	218.5	224.2	235.1	238.0	2
Gross Private Domestic Investment	35.0	41.5	49.8	38.5	55.9	57.7	50.4	50.6	48.9	
Net Exports of Goods and Services	.2	8.0	2.0	2.6	.2	2.2	1.2	-.9	1.0	
Government Purchases of Goods and Services	18.5	37.2	42.1	47.2	45.1	63.3	77.7	84.3	75.3	
Federal Reserve Board Industrial Production Index (1957 = 100)*	38	65	68	64	74	81	84	91	85	

SOURCES FOR HISTORICAL DATA:

1. Years 1929-1955: U.S. Income and Output 1958, Table I-2, p. 118 and Table VII-6, p. 224.
2. Years 1956-1962: Survey of Current Business (July, 1963), Table 4, p. 14 and Table 65, p. 37.

*Total industrial production index, covering all manufacturing and mining industries and utilities, derived from (a) Economic Almanac, 1962, p. 151 and 158; (b) Business Statistics, 1961, pp. 14-16; and (c) Federal Reserve Bulletin (July, 1962). The FRB industrial production index is projected on the basis of the relationship between that index and GNP during the 1929-1962 period. The long-run relationship between GNP and the FRB index, as measured by the ratio of GNP to the FRB index, has generally been a declining one ranging from 4.4 to 4.1 during the postwar period. The GNP/FRB index ratio is projected to decrease to 3.6 by the end of the projection period.

TABLE IV

ATIONAL PRODUCT BY MAJOR TYPE OF PRODUCT AND PURCHASER
(GNP in Billions of $ at 1954 Prices)

											Projections				
1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1970	1980	1990	2000	2010
353.5	369.0	363.1	392.7	400.9	408.6	401.3	428.6	439.9	447.7	474.8	626.0	874.3	1202.8	1677.2	2271.2
75.1	80.8	71.6	83.1	84.9	85.5	71.7	82.9	84.2	81.3	91.0	137.1	198.6	208.3	392.5	538.3
28.5	33.1	32.4	39.6	38.0	38.5	35.5	41.0	42.2	41.5	45.6	60.1	86.6	121.5	171.1	233.9
21.8	22.5	20.8	22.5	25.0	24.6	19.4	21.4	22.7	21.0	23.8	37.6	52.5	72.2	100.6	136.3
20.9	21.8	17.7	14.7	15.4	17.0	16.2	16.6	14.3	16.3	16.5	28.2	45.5	71.0	109.0	159.0
2.7	2.4	3.2	3.4	3.8	4.3	2.9	1.0	3.0	2.8	2.6	} 11.2	14.0	15.6	11.8	9.1
1.2	1.0	-2.5	3.0	2.7	1.0	-2.4	3.0	2.1	-.3	2.6					
121.8	126.9	125.9	133.8	136.5	137.9	139.8	145.9	148.8	151.9	158.1	197.8	264.0	347.6	467.9	620.0
115.0	118.3	119.3	125.4	130.3	132.6	133.3	138.7	141.4	143.3	147.8	182.2	240.4	317.5	427.6	565.5
6.2	10.8	6.6	6.4	4.6	4.3	7.1	6.4	6.9	7.1	9.3	10.0	14.9	21.7	31.9	45.4
-.9	-1.8	-.9	-1.1	-.2	.3	-1.4	-2.1	-.5	-.5	-1.2	} 5.6	8.7	8.4	8.4	9.1
1.5	-.5	.9	3.1	1.8	.7	.8	2.9	1.1	2.0	2.2					
119.8	122.5	124.1	130.2	135.5	141.2	145.2	151.4	158.8	165.3	174.4	221.6	314.7	441.4	630.6	860.8
80.8	83.7	86.3	91.0	96.0	100.1	104.4	109.2	114.5	118.9	124.3	164.0	231.7	319.9	447.8	606.4
39.7	40.4	39.0	40.4	40.7	41.9	42.5	43.3	45.0	46.5	49.7	59.5	83.9	119.1	174.4	243.0
-.6	-1.6	-1.3	-1.3	-1.1	-.8	-1.7	-1.0	-.7	.0	.4	-1.9	-.9	2.4	8.4	11.4
36.9	38.8	41.6	45.6	43.9	44.0	44.5	48.3	48.1	49.2	51.4	69.5	97.0	133.5	186.2	252.1
26.0	27.6	29.7	33.9	32.3	31.8	31.1	34.4	34.4	34.7	36.7	50.1	67.3	90.2	120.8	156.7
10.9	11.2	11.9	11.7	11.6	12.2	13.5	13.9	13.8	14.5	14.7	19.4	29.7	43.3	65.4	95.4
224.2	235.1	238.0	256.0	264.3	271.2	273.2	288.9	298.1	303.6	317.6	405.6	558.7	759.0	1046.6	1405.9
50.4	50.6	48.9	62.5	61.7	58.1	49.0	61.7	60.2	57.5	65.2	102.7	139.0	181.6	236.5	304.3
1.2	-.9	1.0	.9	2.5	3.8	-.2	-2.1	1.7	2.3	1.8	.6	2.6	7.2	13.4	18.2
77.7	84.3	75.3	73.2	72.3	75.5	79.3	80.1	79.9	84.3	90.2	117.1	174.0	255.0	380.7	542.8
84	91	85	96	99	100	93	105	108	109	117	159	227	321	460	631

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TABLE V

PERCENT DISTRIBUTION OF REAL GROSS NATIONAL PRODUCT BY MAJOR TYPE OF PRODUCT AND PURCHASER

	1929	1957	1958	1959	1960	1961	1962	1970	1980	1990	2000	2010
Total GNP	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Durables	16.9	20.9	17.9	19.4	19.1	18.2	19.1	21.9	22.7	23.3	23.4	23.7
Personal Consumption Expenditures	8.2	9.4	8.9	9.6	9.6	9.3	9.6	9.6	9.9	10.1	10.2	10.3
Producers' Durables	6.1	6.0	4.8	5.0	5.2	4.7	5.0	6.0	6.0	6.0	6.0	6.0
Government Purchases	0.4	4.2	4.1	3.9	3.3	3.7	3.5	4.5	5.2	5.9	6.5	7.0
Net Exports	0.8	1.1	0.7	0.2	0.7	0.6	0.5	1.8	1.6	1.3	0.7	0.4
Changes in Business Inventories	1.4	0.2	-0.6	0.7	0.3	-0.1	0.5					
Nondurables	35.5	33.7	34.8	34.0	33.8	33.9	33.3	31.6	30.2	28.9	27.9	27.3
Personal Consumption Expenditures	35.9	32.4	33.2	32.4	32.1	32.0	31.1	29.1	27.5	26.4	25.5	24.9
Government Purchases	0.6	1.0	1.8	1.5	1.6	1.6	2.0	1.6	1.7	1.8	1.9	2.0
Net Exports	-1.2	0.1	-0.4	-0.5	-0.1	-0.1	-0.3	0.9	1.0	0.7	0.5	0.4
Changes in Business Inventories	0.2	0.2	0.2	0.6	0.2	0.4	0.5					
Services	33.2	34.6	36.2	35.3	36.1	36.9	36.8	35.4	36.0	36.7	37.6	37.9
Personal Consumption Expenditures	26.4	24.5	26.0	25.5	26.0	26.5	26.2	26.2	26.5	26.6	26.7	26.7
Government Purchases	6.3	10.3	10.6	10.1	10.3	10.4	10.5	9.5	9.6	9.9	10.4	10.7
Net Exports	0.5	-0.2	-0.4	-0.3	-0.2	.0	0.1	-0.3	-0.1	0.2	0.5	0.5
Construction	14.4	10.8	11.1	11.3	11.0	11.0	10.8	11.1	11.1	11.1	11.1	11.1
Private	11.5	7.8	7.7	8.0	7.8	7.8	7.7	8.0	7.7	7.5	7.2	6.9
Government	2.9	3.0	3.4	3.3	3.2	3.2	3.1	3.1	3.4	3.6	3.9	4.2
Total Pers. Cons. Exps.	70.5	66.4	68.1	67.4	67.8	67.8	66.8	64.9	63.9	63.1	62.4	61.9
Total Govt. Exps.	10.2	18.5	19.8	18.7	18.2	18.8	19.0	18.7	19.9	21.2	22.7	23.9
Total Gross Private Domestic Investment	19.3	14.2	12.2	14.4	13.7	12.8	13.7	16.3	15.9	15.1	14.1	13.4
Net Exports	.1	1.0	- .1	- .5	.4	.5	.4	0.1	0.3	0.6	0.8	0.8

Sources: For historical data, see Table IV. Projections are derived from procedures and equations outlined in this appendix, and are based on GNP annual rate of growth of 3.4% between 1960 and 1980 and 3.2% between 1980 and 2010.

TABLE VI

REGRESSION EQUATIONS USED FOR DERIVING GNP COMPONENTS

Equations	Form	Data Used
1. Personal Income	$Y_p = 5.9338 + .8083Y_{GNP} - .5050t$ Y_p = Personal Income Y_{GNP} = GNP t = Time: 1929 = 0	time series: 1929-1940 and 1947-1960 in constant 1954 dollars
2. Disposable Income (or Tax: $Y_p - Y_d$)	$Y_d = 2.8057 + .8380Y_p + .7554t$ Y_d = Disposable Personal Income Y_p = Personal Income t = Time: 1929 = 0	same as above
3. Personal Consumption Expenditures	$C_t = 10.2700 + .8856Y_d + .1444t$ C_t = Total Consumption Expenditures Y_d = Disposable Personal Income t = Time: 1929 = 0	same as above, in 1957-1959 dollars*

TABLE VI (Continued)

4. Personal Consumption Expenditure Components		time series: 1947-1960 in 1957-1959 dollars*
Durable Goods	$C_d = -11.2321 + .1737C_t$	
Nondurable Goods	$C_{nd} = 27.9014 + .3835C_t$	
Services	$C_s = -16.7354 + .4430C_t$	
	C_t = Personal Consumption Expenditures (total)	
	C_d = Durable Goods Expenditures	
	C_{nd} = Nondurable Goods Expenditures	
	C_s = Service Expenditures	
5. Government Expenditure Components		time series: 1947-1960 in 1957-1959 dollars*
Durable	$G_d = -7.8119 + .3085G_t$	
Nondurable	$G_{nd} = .0260 + .0834G_t$	
Services	$G_s = 9.1776 + .4307G_t$	
Construction	$G_c = -1.3761 + .1772G_t$	
	G_t = Government Expenditures (total)	
	G_d = Government Expenditures--durable goods	
	G_{nd} = Government Expenditures--nondurable goods	
	G_s = Government Expenditures--services	

*The 1957-1959 constant dollar series is used because of the availability of price indexes to deflate individual commodity and service expenditures (see U.S. Department of Labor, BLS Consumer Price Index (1957-1959 = 100) Price Indexes for Selected Items and Groups Annual Averages, 1935-1961).

Detailed Consumption Expenditure Projections

The 52 individual expenditure groups for which equations are derived in this Appendix can be used in conjunction with our bridging table to derive household demand for the industry sectors of the model. The personal consumption expenditure items that are usually listed in published sources were consolidated from approximately 100 to 52 items so as to enable us to allocate them to various industries.

Table VII shows a breakdown of projected total consumption expenditures into 52 individual commodity and noncommodity expenditure groups. The projected distribution was derived through use of the equations shown in Table VIII and by testing their implications with the previously given GNP growth rates.

Estimating equations for individual expenditure items were obtained by regressing the three major expenditure groups (durables, nondurables, and services) against total consumption expenditures, and individual expenditure subgroups against the appropriate major group. A test was then made to determine whether the sum of durable goods, nondurable goods, and services expenditures, each group having been projected on the basis of a regression against total consumption expenditures, would equal our estimate of total consumption expenditures regressed on an aggregate basis against disposable income. The difference between the two totals was less than 1%, and each component was then adjusted so that their sum would equal the control total. The same test was applied to the subcategory components. Here the maximum disparity was 5% for the year 2010 projection. Once again, adjustments were made to force agreement with the control totals. In a few cases, expenditures were regressed against other independent variables, such as agricultural employment, population, and size of the armed forces.

TABLE VII

HISTORICAL AND PROJECTED PERCENTAGE DISTRIBUTION OF PERSONAL CONSUMPTION EXPENDITURES, BY TYPE

(Based on Equations in Table VIII and Projected GNP Distribution in Tables IV and V)

Major Expenditure Group*	Commodity Code	Expenditure Items	1947	1949	1951	1953	1955	1957	1959	1960	1970	1980	1990	2000	2010
		Total Consumption Expenditures	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
D	2-7-0	Jewelry and watches	.008	.007	.006	.006	.007	.007	.006	.007	.006	.006	.006	.005	.005
D	5-1-0	Furniture, Incl. mattresses & bed springs	.014	.013	.013	.014	.016	.015	.016	.015	.016	.017	.017	.018	.018
D	5-2-0	Kitchen & other household appliances	.013	.015	.014	.014	.016	.016	.016	.015	.017	.018	.019	.019	.019
D	5-3-0	China, glassware, tableware & utensils	.009	.009	.009	.008	.008	.007	.006	.006	.005	.004	.003	.002	.001
D	5-4-0	Other durable house furnishings	.012	.012	.013	.011	.011	.012	.012	.011	.010	.010	.009	.009	.009
D	6-2-0	Ophthalmic products & orthopedic appliances	.002	.002	.002	.002	.003	.003	.004	.004	.004	.005	.005	.005	.005
D	8-1-1	New cars and net purchases of used cars	.032	.045	.045	.047	.065	.053	.046	.049	.060	.066	.070	.072	.074
D	8-1-2	Tires, tubes, accessories and parts	.010	.010	.009	.009	.009	.009	.009	.010	.008	.007	.007	.007	.007
D	9-4-0	Wheel goods, durable toys, sports, eqpt.; boats & pleasure aircraft	.005	.004	.004	.004	.005	.006	.006	.006	.007	.008	.009	.009	.009
D	9-5-0	Radio & television receivers, records and musical instruments	.007	.008	.008	.010	.010	.010	.011	.011	.013	.014	.015	.016	.016
ND	1-1-0	Food purchased for off-premises consumption	.220	.207	.196	.198	.195	.196	.192	.190	.180	.169	.165	.160	.156
ND	1-3-0	Food furnished government	.006	.001	.007	.007	.005	.004	.004	.004	.003	.002	.002	.001	.001
ND	1-4-0	Food produced and consumed on farms	.016	.012	.010	.008	.007	.006	.004	.004	.002	.001	.001	negligible	
ND	1-5-0	Tobacco products	.025	.025	.024	.024	021	.022	.022	.022	.019	.017	.016	.015	.015
ND	2-1-0	Shoes & other footwear	.019	.018	.016	.015	.015	.013	.013	.013	.010	.007	.006	.005	.004
ND	2-3-0	Clothing & accessories	.077	.076	.073	.075	.073	.074	.075	.073	.072	.075	.069	.068	.067
ND	3-1-0	Toilet articles and preparations	.007	.007	.007	.007	.007	.008	.008	.009	.009	.010	.011	.011	.011
ND	5-5-0	Semi-durable house furnishings	.009	.010	.011	.010	.009	.009	.009	.009	.008	.008	.007	.007	.007
ND	5-6-0	Cleaning & polishing preparations	.010	.010	.010	.009	.009	.010	.010	.010	.010	.010	.010	.010	.010

TABLE VII (Continued)

Major Expenditure Group*	Commodity Code	Expenditure Items	1947	1949	1951	1953	1955	1957	1959	1960	1970	1980	1990	2000	2010
ND	5-7-0	Stationery & writing supplies	.003	.003	.003	.003	.003	.003	.003	.003	.004	.004	.004	.004	.004
ND	5-8-4	Utilities, other fuel, ice, etc.	.021	.017	.017	.014	.014	.012	.012	.012	.007	.004	.003	.002	.002
ND	6-1-0	Drug preparations	.008	.008	.009	.010	.010	.011	.011	.012	.014	.015	.016	.017	.017
ND	9-3-0	Toys & sports supplies	.004	.005	.007	.007	.007	.007	.008	.008	.009	.010	.011	.011	.011
ND	1-2-0	Purchased meals & beverages	.063	.060	.062	.062	.057	.055	.052	.051	.046	.041	.038	.036	.034
ND	8-1-4	Gasoline and oil	.024	.028	.031	.035	.035	.035	.035	.036	.042	.045	.048	.050	.051
ND	9-1-0, 9-2-0	Books, maps & magazines	.013	.013	.013	.012	.012	.012	.012	.012	.011	.010	.009	.009	.009
ND	9-7-0	Flowers, seeds & potted plants	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003
S	2-5-0	Cleaning, dyeing, etc.	.009	.009	.008	.008	.007	.007	.006	.006	.004	.002	.002	.001	.001
S	2-8-0	Other services for clothing & accessories	.002	.002	.002	.002	.002	.002	.002	.002	.001	.002	.001	.001	.001
S	5-8-1	Electricity	.007	.009	.010	.011	.012	.014	.015	.015	.019	.022	.023	.025	.025
S	5-8-2	Gas	.005	.005	.007	.007	.008	.009	.009	.009	.011	.013	.014	.014	.014
S	5-11-0	Household operations	.006	.006	.006	.006	.006	.006	.006	.007	.007	.007	.007	.007	.007
S	6-8-0	Funeral and burial	.007	.006	.006	.006	.005	.005	.005	.005	.004	.003	.002	.002	.001
S	7-7-0	Other personal business services	.004	.004	.004	.003	.003	.003	.003	.003	.003	.002	.002	.002	.002
S	8-1-4	Transit fares	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001
S	8-3-4	Transportation, other	negligible												
S	9-10-0	Commercial participant amusements	.002	.002	.002	.002	.003	.002	.003	.003	.003	.003	.003	.003	.003
S	9-12-0	Other recreation services	.003	.003	.003	.003	.003	.004	.004	.004	.004	.005	.005	.005	.005
S	10-3-0	Other private education and research	.002	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003
S	12-1-0	Foreign travel	.004	.006	.005	.005	.006	.006	.007	.007	.009	.012	.016	.020	.025
S	2-2-0, 2-6-0 3-2-0	Shoe, laundering & personal care	.014	.013	.012	.011	.011	.010	.010	.010	.008	.007	.006	.005	.005
S	4-1-0, 4-2-0, 4-3-0, 5-8-3	Housing, rent & water service	.110	.110	.120	.120	.120	.120	.130	.130	.130	.140	.140	.140	.140
S	4-4-0	Housing	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004
S	5-9-0	Telephone, telegraph cable & wireless	.008	.010	.010	.011	.011	.012	.013	.013	.014	.013	.012	.010	.008

TABLE VII (Continued)

Major Expenditure Group	Commodity Code	Expenditure Items	1947	1949	1951	1953	1955	1957	1959	1960	1970	1980	1990	2000	2010
S	5-10-0, 9-6-0	Domestic and recreation	.016	.015	.017	.014	.014	.014	.013	.013	.012	.011	.010	.009	.008
S	6-3-0, 6-5-0, 6-4-0, 6-6-0, 7-5-0	Medical, dentists and physicians	.039	.041	.041	.041	.040	.042	.043	.043	.043	.044	.043	.044	.044
S	6-7-0, 7-3-0 7-1-0, 7-4-0 7-2-0, 7-6-0 8-1-6	Medical & hospitalization insurance & personal business	.039	.042	.048	.052	.054	.058	.060	.062	.072	.080	.086	.089	.091
S	8-1-3	Auto repairs	.014	.015	.015	.016	.015	.014	.015	.015	.015	.015	.015	.015	.015
S	8-2-1, 8-2-2, 8-3-2	Street cars, buses, and taxis	.024	.019	.015	.012	.009	.008	.006	.006	.003	.001	.001	negligible	
S	8-2-3, 8-3-1, 8-3-3	Transportation	.006	.004	.004	.004	.004	.004	.004	.004	.003	.003	.002	.002	.002
S	9-8-1, 9-8-3, 9-8-2, 9-11-0	Motion pictures,	.015	.013	.011	.010	.008	.008	.007	.007	.004	.002	.001	.001	negligible
S	9-9-0, 10-2-0, 10-1-0, 11-0-0	Recreation, private religious and welfare activities	.025	.025	.023	.023	.023	.024	.026	.027	.026	.026	.027	.027	.027

*D = Durable goods
ND = Nondurable goods
S = Services

Note: Totals may not add due to rounding.

TABLE VIII

REGRESSION EQUATIONS FOR PERSONAL CONSUMPTION EXPENDITURE COMPONENTS

(Derived on the Basis of 1947-1960 Time Series Data)

Expenditure Items Code Number*	Form of Equations	Independent Variables
1-1-0	$C_1 = -.0600 + .4053\ C_{nd}$	C_{nd} = Personal consumption expenditures on non-durable goods
1-3-0	$C_2 = .8309 + .2079\ E_m$	E_m = Number of members in Armed Forces
1-4-0	$C_3 = -.8914 + .0111\ C_{nd}$	C_{nd} = see above
1-5-0	$C_4 = 1.3886 + .0358\ C_{nd}$	see above
2-1-0	$C_5 = 3.4157 + .0042\ C_{nd}$	see above
2-3-0	$C_6 = -3.5874 + .1798\ C_{nd}$	see above
3-1-0	$C_7 = -2.1988 + .0325\ C_{nd}$	see above
5-5-0	$C_8 = .0925 + .0187\ C_{nd}$	see above
5-6-0	$C_9 = -.9618 + .0271\ C_{nd}$	see above
5-7-0	$C_{10} = -.8569 + .0128\ C_{nd}$	see above
5-8-4	$C_{11} = 1.7950 + .3023\ E_a$	E_a = Agricultural Employment
6-1-0	$C_{12} = -3.9491 + .0512\ C_{nd}$	C_{nd} = see above
9-3-0	$C_{13} = -2.5697 + .0339\ C_{nd}$	see above
1-2-0	$C_{14} = 4.8262 + .0793\ C_{nd}$	see above
8-1-4	$C_{15} = -10.6051 + .1499\ C_{nd}$	see above
9-1-0	$C_{16} = .3711 + .0219\ C_{nd}$	see above
9-7-0	$C_{17} = -.5126 + .0097\ C_{nd}$	see above

TABLE VIII (Continued)

Expenditure Items Code Number*	Form of Equations	Independent Variables
2-7-0	$C_{18} = .7603 + .0289\ C_d$	C_d = Personal consumption expenditures on durable goods
5-1-0	$C_{19} = .1794 + .1077\ C_d$	same as above
5-2-0	$C_{20} = -.1131 + .1170\ C_d$	same as above
5-3-0	$C_{21} = 1.9948 + .0010\ C_d$	same as above
5-4-0	$C_{22} = 1.5332 + .0460\ C_d$	same as above
6-2-0	$C_{23} = -.4287 + .0345\ C_d$	same as above
8-1-1	$C_{24} = -3.3102 + .4621\ C_d$	same as above
8-1-2	$C_{25} = 1.1959 + .0361\ C_d$	same as above
9-4-0	$C_{26} = -.6623 + .0592\ C_d$	same as above
9-5-0	$C_{27} = -.9282 + .1020\ C_d$	same as above
2-5-0	$1/C_{28} = .4003 + .0012\ C_s$	C_s = Personal consumption expenditures on services
2-8-0	$C_{29} = .3003 + .0016\ C_s$	same as above
5-8-1	$C_{30} = -3.6077 + .0678\ C_s$	same as above
5-8-2	$C_{31} = -1.8127 + .0384\ C_s$	same as above
5-11-0	$C_{32} = -.1539 + .0179\ C_s$	same as above
6-8-0	$C_{33} = 1.2877 + .0010\ C_s$	same as above
7-7-0	$C_{34} = .5266 + .0033\ C_s$	same as above
8-1-5	$C_{35} = .0673 + .0015\ C_s$	same as above
8-3-4	$1/C_{36} = -39.3829 + .7078\ C_s$	same as above

TABLE VIII (Continued)

Expenditure Items Code Number*	Form of Equations	Independent Variables
9-10-0	$C_{37} = -.1776 + .0083\, C_s$	C_s = Personal consumption expenditures on services
9-12-0	$C_{38} = -.2927 + .0120\, C_s$	same as above
10-3-0	$C_{39} = .0319 + .0066\, C_s$	same as above
12-1-0	$\log C_{40} = -3.3377 + 1.7710 \log C_s + 0.0235 \log t$	same as above
2-2-0 2-6-0 3-2-0	$C_{41} = 1.9983 + .0084\, C_s$	same as above
4-1-0 4-2-0 4-3-0 5-8-3	$C_{42} = -2.689 + .3460\, C_s$	same as above
4-4-0	$C_{43} = .0530 + .0093\, C_s$	same as above
5-9-0	$C_{44} = -22.392 + 12.8570 \log C_s - .284 \log t$	same as above
5-10-0 9-6-0	$C_{45} = 2.0879 + .0174\, C_s$	same as above
6-3-0 6-4-0 6-5-0 6-6-0 7-5-0	$C_{46} = .2788 + .1065\, C_s$	same as above
6-7-0 7-1-0 7-2-0 7-3-0 7-4-0 7-6-0 8-1-6	$C_{47} = -9.6681 + .2371\, C_s$	same as above

TABLE VIII (Continued)

Expenditure Items Code Number*	Form of Equations	Independent Variables
8-1-3	$C_{48} = .4204 + .0346\, C_s$	C_s = Personal consumption expenditures on services
8-2-1 8-2-2 8-3-2	$1/C_{49} = -.2798 + .0065\, C_s$	same as above
8-2-3 8-3-1 8-3-3	$C_{50} = .7285 + .0035\, C_s$	same as above
9-8-1 9-8-2 9-8-3 9-11-0	$1/C_{51} = .1684 + .0024\, C_s$	same as above
9-9-0 10-1-0 10-2-0 11-0-0	$C_{52} = -.1208 + .0656\, C_s$	same as above

*For description of expenditure items, see Table VII.

APPENDIX D

THE DEMOGRAPHIC PROJECTION: POPULATION AND LABOR FORCE IN THE OHIO RIVER BASIN

POPULATION

The population of the Ohio River Basin was projected to the year 2010 by using the component or cohort-survival method which permits separate assumptions for each of the three components of population change. As explained in Chapter IV, the purpose of the demographic projection was to derive independent estimates of the future supply of labor in the Basin. Insofar as possible, we followed the assumptions used in the national population projection which, in turn, were based on the Census Bureau Series III projection (See Appendix C). The assumptions, sources, and data used in projecting each of the components of population change for the Ohio River Basin are discussed in detail below.

A. Births

It was first determined that historically the Basin's crude birth rate was somewhat lower than that of the nation. Then, using actual age-specific birth rates for Indiana, Kentucky, Ohio, Pennsylvania and West Virginia, and weighting them by the number of women in each age class in the Basin sector of each state, we derived a set of age-specific rates for the Ohio River Basin in 1960. This resulted in a Basin-wide birth rate of 114.9 per 1,000 women age 15 - 44 (which corresponds to a gross reproduction rate of 1.73*), as compared with a U.S. birth rate of 118.0 (corresponding to a gross reproduction rate of 1.78) for the same year.

The following tabulation gives our specific assumptions about future changes in fertility and compares them with the Census Bureau's Series III assumptions for the nation. It shows that by 1965-70, the Basin's gross reproduction rate is assumed to be the same as the nation's and that it then follows national levels to the end of the projection period.

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*The gross reproduction rate for a given year is the total number of female babies a woman living through her entire reproduction period would have at the age-specific birth rates prevailing in the given year.

	Gross Reproduction Rate	
	Ohio River Basin	United States
1955-57	n.a.	1.79
1960	1.73	1.78
1965-1980	1.54	1.54
(The 1949-51 level will be reached by 1965-70 and will be maintained until 1975-80)		
2005-2010	1.28	1.28
(The 1942-44 level will be reached by 2005-2010)		

B. Deaths

Applying the national age-specific death rates for 1950 and 1960 to the corresponding Ohio River Basin populations gave estimates of total deaths which closely agreed with the actual number of deaths in the Basin in those years obtained from the County and City Data Books. We, therefore, used the same mortality assumptions as those used by the Census Bureau in its national population projections. They are the average of high and low mortality assumptions developed by the Social Security Administration and published in Illustrative United States Population Projections, Actuarial Study No. 46, May 1957.

C. Migration

In a sub-national area such as the Ohio River Basin, inward and outward migration constitute the most significant component of population change. Hence, the assumptions made with regard to future rates of net migration will have an important bearing upon projected rates of total population increase.

First we established historical rates of migration for the Basin. Using state migration rates computed for each decade 1870 to 1950 by Lee and others,* we weighted the migration rates for Indiana, Kentucky, Ohio, Pennsylvania and West Virginia (these states contained over 88 percent of the Basin's

*Lee, Miller, Brainerd, and Easterlin, Population Redistribution and Economic Growth, United States, 1870-1950, Vol. 1, Table P-1, p. 107, American Philosophical Society, Philadelphia, 1957.

population in 1900, and 91 percent in 1960) by the number of people living in each state's Basin share, and obtained the following estimates for the Basin:

Decade	Migration Per 1,000 Average Population
1870-80	-13.0
1880-90	- 6.7
1890-00	+14.3
1900-10	+11.3
1910-20	+16.1
1920-30	-18.8
1930-40	-22.3
1940-50	-39.4
1950-60	-49.8*

*The rate for the 1950-60 decade was computed from migration data in the County and City Data Book, 1962, using the same method as used by Lee for the earlier decades.

From the above migration figures it appears that net out-migration from the Ohio River Basin started in the 1920's and has increased over time. We decided to project out-migration for the first five years of the 1960's at the same rate as that occurring during a five year period in the 1950's, or about 27 persons per 1,000 population. This rate was decreased by 2.5 per 1,000 each pentad thereafter, so that during the last five-year span of the projection period, 2005-2010, it would reach 4.5 per 1,000, with the implication that net migration would be zero by 2015-2020. This decline in out-migration over the fifty-year projection period bears out our assumption that rates of growth in all areas of the United States will draw closer to each other as the country matures and the relative disadvantage of the Ohio River Basin is gradually eliminated.

The effect of the projected gradual decline in the rate of out-migration is that the population of the Ohio River Basin, which was 14.4% of the U.S. population in 1900 and had dropped to 10.6% by 1960, is projected to continue to decline as a percentage of contiguous U.S. population but at a decreasing rate. In 1980 it is projected to account for 9.3% of contiguous U.S. population, and by 2010, for 8.4% (Table I).

TABLE I

POPULATION OF THE OHIO RIVER BASIN, 1900-1960,
WITH PROJECTION TO 2010
(Thousands of Persons)

	Males	Females	Total[1]	Total as Percent of Contiguous United States
Actual Past:[2]				
1900			10,928	14.4
1910			12,411	13.5
1920			13,707	13.0
1930			15,062	12.3
1940			16,043	12.2
1950	8,649	8,729	17,378	11.5
1960	9,348	9,653	19,001	10.6
Projection:				
1970	9,986	10,503	20,488	9.9
1980	11,020	11,649	22,669	9.3
1990	12,333	12,984	25,317	8.8
2000	13,833	14,433	28,265	8.5
2010	15,609	16,103	31,713	8.4

1. Parts may not add to total due to rounding.

2. Source: U.S. Census of Population

LABOR FORCE

The labor force of the Ohio River Basin was projected by using the same age-sex labor participation rates as those used in projecting the U.S. labor force (see Appendix C), but making certain adjustments which are described below.

First it was determined that the base-year labor force participation rates in the Basin were somewhat lower than those in the nation. This finding is supported by the knowledge that the Basin is an area of net out-migration (presumably of persons in the working age groups) and that the population is less urbanized than in the nation as a whole.

We then assumed that the difference between the regional and the national participation rates would gradually diminish in the future, so that by 2020 regional rates would equal national rates. The projection results are shown in Table II.*

The Armed Forces and the Civilian Labor Force

In 1960, about 86,300 members of the armed forces were stationed in the Ohio River Basin. This represents approximately 3.5% of the nation's armed forces in that year. We have assumed, in the absence of authoritative guidelines, that the proportion of U.S. forces stationed in the Basin in 1960

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*A special data problem had to be dealt with due to historical differences in labor force coverage between the Bureau of the Census and the Bureau of Labor Statistics. Our national labor force projections were based on BLS participation rates because they are considered to be more sensitive to expected changes in the age-sex distribution of the labor force. With the above-noted downward adjustments due to regional differences in participation levels, the national BLS rates were also used for the projection of the Basin's labor force. The results, however, had to be scaled down by about 3% for males and 4% for females to bring the projected labor force figures into line with the Census of Population labor force total in the base year.

will continue throughout the projection period. In accordance with this assumption, the following projections of the civilian labor force were computed:

	Total Labor Force	Armed Forces	Civilian Labor Force
	(in thousands of persons)		
1960	6,918	85	6,833
1970	7,535	81	7,454
1980	8,348	76	8,272
1990	9,413	73	9,340
2000	11,116	71	11,045
2010	13,086	69	13,017

TABLE II

TOTAL LABOR FORCE OF THE OHIO RIVER BASIN, 1960-2010, WITH PARTICIPATION RATES BY SEX

	Labor Force (thousands of persons)			Participation Rates (as percentage of population, age 14 and over)		
	Male	Female	Total	Male	Female	Total
1960	4,855	2,063	6,918	74.6	29.8	51.6
1970	5,076	2,459	7,535	72.5	32.2	51.5
1980	5,551	2,797	8,348	72.3	33.2	51.8
1990	6,196	3,217	9,413	72.2	34.2	52.4
2000	7,248	3,868	11,116	73.5	36.3	54.2
2010	8,476	4,610	13,086	74.9	38.4	56.2

Source: 1960 labor force is from Census of Population. Projection figures are based on population projections in Table I, and on Bureau of Labor Statistics' national participation rates, adjusted downward for regional differences and scaled down to conform with the Census Bureau's 1960 labor force total.

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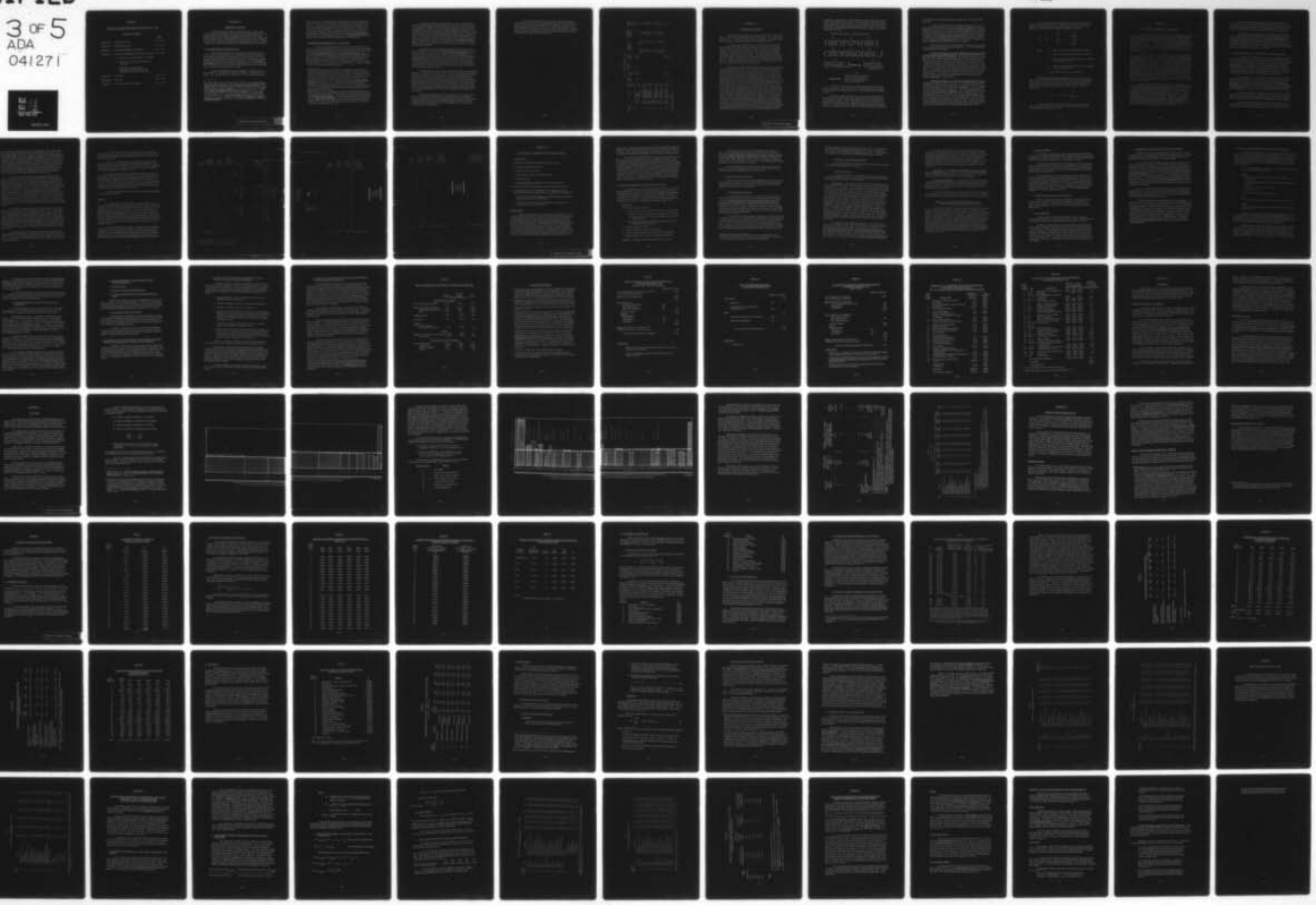
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APPENDIX E

DERIVATION OF OHIO RIVER BASIN BASE YEAR VALUES - 1960

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APPENDIX E-1

GROSS OUTPUT LEVELS

Two basic steps are required to determine base-year gross output levels for the Ohio River Basin: (1) derivation of national gross output levels for major industry sectors by updating an aggregated version of the 200-sector National Table for 1947, and (2) scaling down of these national gross output levels to the Ohio River Basin, and distribution of the regional gross manufacturing output thus derived among the individual manufacturing industry sectors. A detailed account of the methodology used in these two computational steps is given below.

1. U.S. GROSS OUTPUT LEVELS FOR 1960

The 1947 Interindustry Relations Study (Division of Interindustry Economics, Bureau of Labor Statistics, U.S. Department of Labor) provides the most recent and comprehensive tabulation of the flow of goods and services in the national economy, using an input-output framework. In this study, detailed industry output valuations were made by modifying and reclassifying Census of Manufactures and other data for undercoverage, duplication, and other deficiencies.* We used the results of this study to approximate the national output levels of major industrial sectors for 1960, as follows:

First, we aggregated the 200-sector (Table I: "Interindustry Flow of Goods and Services by Industry of Origin and Destination, Continental United States, 1947," published October 1952) into the 27-sector framework of the Ohio

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*See, for example, Bureau of Labor Statistics Report No. 33, General Explanations of the 200-Sector Tables: The 1947 Interindustry Relations Study, 1953; National Bureau of Economic Research Conference on Income and Wealth, Input-Output Analysis, Technical Supplement, 1954, esp. Section 6; W.W. Leontief, (ed.), Studies in the Structure of the American Economy, New York, Oxford University Press, 1953; W.D. Evans and M. Hoffenberg, "The Interindustry Relations Study for 1947," Review of Economics and Statistics, XXXIV (May, 1952), pp. 92-142; K.J. Arrow and M. Hoffenberg, A Time Series Analysis of Interindustry Demands, Amsterdam, North-Holland Publishing Co., 1959, esp. pp. 69-72, 100-102.

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River Basin study. By applying indexes of growth in gross product originating,* 1960/1947, to these 1947 national gross output levels for the major industry sectors (i.e., agriculture-forestry-fisheries, coal mining, other mining, construction, manufacturing, transportation-communications-utilities, wholesale and retail trade, finance-insurance-real estate, and services), it is possible to approximate the 1960 gross output levels of these sectors. Indexes of growth in gross product originating can be computed from the Survey of Current Business (October 1962, p. 14 and September 1963, p. 10). Having obtained control totals, we then scaled them down to the Ohio River Basin as described below.

2. OHIO RIVER BASIN GROSS OUTPUT LEVELS, 1960

To derive the Basin equivalents of national gross output levels for each industry, 1960 regional output shares for each major industry sector were approximated for the nonmanufacturing industries by computing Basin employment shares from the 1960 Census of Population and the 1958 Census of Minerals. These shares were determined by summing employment in each nonmanufacturing industry sector in all the counties falling within the Basin, and then expressing the aggregate regional sum as a percent of the respective U.S. employment total. A different procedure was followed for the manufacturing sector as a whole. Here, we used the total U.S. value added in the manufacturing sector in 1958, as updated to 1960, to derive the regional output share.**

*Gross product originating in an industry is that industry's contribution to the nation's total output of goods and services, as defined and covered within the framework of the national income and product accounts. "Industry gross product can be measured as the amount by which an industry's total product exceeds the value of the materials and services it buys on current account." (U.S. Department of Commerce, Office of Business Economics, Survey of Current Business (October 1962, p. 15). Gross product originating in an industry is measured at its market value rather than at "factor" cost. In other words, such items as indirect business taxes, (e.g., excise taxes), property tax, sales tax, etc. are included in the value of the industry's product and direct government subsidies are subtracted.

**Basin shares of total U.S. employment in selected manufacturing industries, as derived from the special Census Bureau tabulation for the Ohio River Basin and the 1958 Census of Manufactures, compare favorably with similar shares derived from the 1960 Census of Population. This indicates that there has been no significant change in the Basin's share of national output and employment between 1958 and 1960. Hence, 1958 Ohio River Basin value added shares can be considered to be representative for 1960.

Having approximated the Basin's shares of national output levels for 1960, and applied them to the national gross output estimates, gross output levels for the Basin were obtained for each nonmanufacturing sector and for the manufacturing sector as a whole. Next, the total gross output of manufacturing in the Basin had to be distributed among the individual manufacturing industries. To be acceptable by the model, the distribution procedure should be based on output data for the region that most nearly approximate input-output analysis definitions of output. It was therefore decided to use the regional value of shipments data made available by the special Census Bureau tabulation of the 1958 Census of Manufactures. But before these regional value of shipments data could be used, they had to be updated to 1960, and adjusted for each industry to take account of inventory changes during 1959-1960.

Updating was achieved by applying the weighted value-added growth rates computed from the 1959 and 1960 Annual Survey of Manufactures to the 1958 value of shipments total for the Basin. For each manufacturing industry, rates of growth in value added were first computed for each of the ten Basin states. An average regional value-added growth rate for each industry was then computed by weighting the industry's rate of growth in each state on the basis of that state's 1958 share of the industry's total value added in the region. The updating procedure resulted in an increase of about 15.5 percent in the sales of all manufacturing industries in the region between 1958 and 1960, as compared with a 16 percent increase in the nation as a whole.

Adjustments for inventory changes in the derived 1960 value of shipments data were accomplished in two steps. First, it was assumed that the 1958 national inventory/sales ratios are also applicable to the Basin, thus yielding Basin inventory levels for 1958 for all industries; next it was assumed that the inventory changes for all Basin industries during 1958-1959 and 1959-1960 followed the relative increases or decreases in national inventories for the respective industries, thus yielding the Basin inventory changes for 1959 and 1960. In the specific case of SIC 23, 27 and 31, relative changes in national inventory levels were available only for all three industries combined. Hence, computed changes in Basin inventory levels for this group had to be allocated to each industry on the basis of its sales volume.

After deriving the 1960 value of output totals for all manufacturing industries in the Basin, the individual totals had to be expressed as shares (i.e., as percent of the Basin's "gross manufacturing output"). These percentage figures were then applied to the Basin gross manufacturing output derived for 1960 by scaling down the estimated national total, thus yielding a gross output total for each Basin manufacturing industry.

It should be explained that we did not use the updated and adjusted regional value of shipments data as representing Basin gross manufacturing output in 1960, because value of shipments data are imperfect measures of gross output for input-output purposes, for reasons of duplication, undercoverage and other deficiencies. We elected, instead, to use value of shipments to "distribute" the gross manufacturing output total among the industries after having obtained the Basin total by scaling down the national total.

TABLE I

DERIVATION OF OHIO RIVER BASIN GROSS OUTPUT LEVELS, 1960
(millions of 1960 dollars)

Ohio River Basin Sector Number	SIC	Industry Title	U.S. Gross Output 1947	U.S. GPO Growth Index 1960/1947	U.S. Gross Output 1960	Ohio River Basin Shares of U.S. Output 1960	Ohio River Basin Gross Output 1960	Allocation of Ohio River Basin Manufacturing Control Total		Ohio River Basin Gross Output of Manufacturing Industries 1960	Ohio River Basin Gross Output 1960
			-millions- of dollars	1947=100	-millions- of dollars	-%-	-millions- of dollars	($47,410.0 millions)		-millions- of dollars	-millions- of dollars
All Sectors			432,637.0								95,702.0
1	A (01-09)	Agriculture, Forestry, Fisheries	40,044.3	1.16	46,451.4	9.7	4,510.4				**4,510.4**
2	B (11, 12)	Coal Mining	3,036.4	.69	2,095.1	66.4	1,391.1				1,391.1
3	B (10, 13, 14)	Other Mining	5,926.1	2.40	14,222.6	7.5	1,066.7				1,066.7
4	C (15, 16, 17)	Construction	28,676.9	2.69	77,140.9	9.3	7,174.1				7,174.1
		Manufacturing	189,713.9*	2.10	398,399.2	11.9	47,410.0	(*Ohio River Basin Value of Output*, 1960)		47,410.0*	47,410.0
								-millions-	-percent-		
5	D (20)	Food & Kindred Products	37,824.3					5,833.8	13.48	6,390.9	6,390.9
6	D (22)	Textile Mill Products	9,035.8					215.2	.49	232.3	232.3
7	D (23)	Apparel & Finished Products	13,147.7					635.7	1.47	696.9	696.9
8	D (24, 25)	Lumber & Wood Products	8,853.1					1,081.9	2.50	1,185.3	1,185.3
9	D (26)	Paper & Allied Products	6,901.2					1,136.5	2.63	1,246.9	1,246.9
10	D (27)	*Printing, Publishing*	6,552.2					1,195.4	2.76	1,308.5	1,308.5
11	D (28)	Chemical & Allied	12,376.9					3,577.0	8.27	3,920.8	3,920.8
12	D (29)	Petroleum Refining	7,978.0					911.0	2.11	1,000.4	1,000.4
13	D (30)	Rubber & Misc. Plastics	3,534.9					760.0	1.76	834.4	834.4
14	D (32)	Stone, Clay, Glass Products	3,741.9					2,072.3	4.79	2,270.9	2,270.9
15	D (331, 332, 339)	Ferrous Metals	11,334.1					7,618.6	17.61	8,348.9	8,348.9
16	D (333, 334, 335, 336)	Nonferrous Metals	5,982.4					1,172.8	2.71	1,284.8	1,284.8
17	D (34)	Fabricated Metal Products	10,953.9					3,075.2	7.11	3,370.9	3,370.9
18	D (35)	Machinery Except Electrical	14,048.9					3,677.8	8.50	4,029.9	4,029.9
19	D (36)	Electrical Machinery	8,860.2					4,112.2	9.50	4,504.0	4,504.0
20	D (37, excl. 371)	Transportation Equip.	4,139.2					1,343.3	3.10	1,469.7	1,469.7
21	D (371)	Motor Vehicles	12,673.8					3,053.6	7.06	3,347.1	3,347.1
22	D (21, 31)	Tobacco & Leather Products	5,799.7					1,105.1	2.55	1,209.0	1,209.0
23	D (19, 38, 39)	Ordnance, Inst. & Misc.	5,975.6					685.0	1.58	749.1	749.1
							Total	43,262.3	100.00%		
24	E (40-49)	Transp., Comm., Utilities	30,389.9	2.16	65,642.2	9.8	6,432.9				6,432.9
25	F (50-59)	Trade (wholesale & retail)	55,028.6	1.91	105,104.6	9.6	10,090.0				10,090.0
26	G (60-67)	Finance, Insurance, Real Estate	41,599.2	2.77	115,229.8	7.6	8,757.5				8,757.5
27	H (70-89)	Services	38,221.7	2.55	97,465.5	9.1	8,869.3				8,869.3

*Components may not add up to total due to rounding.

For all explanations, see the accompanying text.

APPENDIX E-2

INTERMEDIATE DEMAND

The intermediate demand total for each industry is the sum of its shipments to all other consuming industries on current account. Thus, intermediate demand refers to "structurally related" flows, as opposed to "autonomous" flows which represent an industry's shipments to the final demand sectors.

In a typical input-output table, the intermediate demand total for a given industry can be found simply by adding across that industry's individual shipments (sales) to all other industries. If, however, the value of individual shipments across each row is not available, then an industry's intermediate demand total must be indirectly determined. For the Ohio River Basin study, interindustry shipments were not available. The methodological framework was therefore designed to dispense with the intermediate demand matrix so as to enable us to circumvent some of the data problems. This required the determination of intermediate demand totals without the need to compute the value of each industry's shipments to each of the other industries.

The indirect method developed for this purpose consists of four general steps: (1) the national 200-sector table of 1947 was aggregated into the 27-sector equivalent of the Ohio River Basin study, yielding not only a 27x27 coefficient matrix but also the Basin's gross output levels for 1947. The latter can be conveniently determined by applying to the aggregated national gross output totals the respective Basin output shares computed separately. (2) The Basin's intermediate demand totals for 1947 were obtained by multiplying each regional gross output total by the corresponding column of national input-output coefficients, and then adding each row across. This step required the assumption that the 1947 national input-output coefficients were also applicable to the Basin's economy. From what we know of the industrial composition of the Basin in relation to that of the nation, this assumption seemed justified. (3) The Basin's 1947 intermediate demand totals were updated to 1960 by assuming that between 1947 and 1960 each intermediate demand total increased at the same rate as the Basin's gross output. In view of the fact that the intermediate demand totals of most industry sectors constitute a substantial portion of gross output levels, a preliminary derivation of intermediate demand estimates for 1960 by this method appeared reasonable. (4) The preliminary intermediate demand estimates were adjusted in the process of reconciling the sum of the individually derived demand totals with the gross output total of each industry sector. As was pointed out elsewhere, the residual difference between the sum of the separately derived intermediate and other demand totals and the gross output total of each industry sector is

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attributable to overestimations, underestimations or both in (a) the intermediate demand total and (b) the net trade total. Thus, the function of the fourth step is to adjust for possible underestimations or overestimations of the intermediate demand totals which might have been introduced by our assuming a fixed relationship between the intermediate demand total and the gross output of each industry between 1947 and 1960.

The four-step method is summarized as follows:

(1) (1) (1)

(1947 U.S. gross output levels ($ millions)) x (Basin's shares of U.S. output levels) = (1947 Basin gross output levels ($ millions))

(2) (2) (3)

x (1947 input-output coefficients matrix (27x27)) = (1947 Basin intermediate demand totals ($millions)) x (1960/1947 gross output growth indexes for the Basin)

(3) (4)

= (1960 Basin intermediate demand totals (preliminary estimate)($ millions)) ⟶ Adjustments for underestimations, overestimations in each intermediate demand total

(4)

⟶ Final 1960 intermediate demand estimates for the Ohio River Basin, as presented in the base-year table (Chapter IV)

The crucial step in deriving the 1960 intermediate demand totals for the Ohio River Basin, as described above, was the determination of the Basin's shares ot national gross output levels in 1947. This step will now be explained in detail.

The Basin's output shares for 1947 consist of value-added shares for the manufacturing industry sectors and of employment shares for the nonmanufacturing industry sectors. Since value-added data were not available for the nonmanufacturing industry sectors, employment shares were substituted as output shares. A comparison of value-added and employment shares in the Basin's manufacturing industry sectors for 1950 did not reveal any significant differences.

Therefore, the use of employment shares was expected to cause no substantial distortions.

In order to determine the Basin's employment shares for 1947, we first computed the 1950 shares from the 1950 Census of Population, and then adjusted them backwards to 1947 on the basis of relative changes in the respective employment shares of the major Basin states (combined) between 1947 and 1950. For the mining sectors, their combined regional employment total for 1947 was first apportioned among coal mining and other mining on the basis of the percent breakdown of such employment in the major Basin states (combined) available from the 1950 Census of Population (Detailed Characteristics). Thereafter, the Basin's employment share in each category was computed.

The derivation of 1947 value-added shares for the manufacturing industries required special ingenuity due to data limitations. The several derivation methods used are detailed below:

Manufacturing Industries for which Employment Ratios Were Available for the Basin Part of Each of the Ten States. The 1947 value-added shares for the region were computed (a) by multiplying 1947 value-added state totals in each industry by the respective employment apportionment ratios (employment in the Basin part of the state as a percent of that industry's total employment in the state) to determine the value-added totals in the Basin part of each state for the manufacturing industries in this category; (b) by adding up each industry's value-added totals in the Basin part of the ten states to obtain the regional value-added totals for each industry; and (c) by expressing each such regional total as a percent of the respective national value-added total available from the 1947 Census of Manufactures. The employment ratios for the Basin part of each of the ten states were obtained for 1947 by interpolating the ratios available from the Census of Population for 1940 and 1950.

Manufacturing Industries for which Such Employment Ratios Were Not Available. For model sectors 9, 12, 13, 15, 16, and 22 an alternative method of deriving the 1947 value-added shares had to be used because of detailed employment data limitations in the 1950 Census of Population. First, we computed total Basin employment in each "group" (i.e., more than one industry sector) for 1950 from the 1950 Census of Population. Next, we approximated the Basin's 1947 total employment in each group by taking the 1950 employment in a group and applying to it the rate of change in the major Basin states' employment in that group between 1947 and 1950. Then we apportioned the 1947 Basin employment in the industry group among the component industries on the basis of that group's employment breakdown in the major Basin states. Finally, we derived 1947 Basin employment shares in each industry by dividing the national employment totals in each industry by the estimated Basin employment in 1947.

To translate each such Basin employment share into value-added share equivalent, we had to adjust the Basin employment shares (1) for the difference between value-added and employment shares and (2) for possible shifts in this difference. This last process is explained symbolically as follows:

$$v_i^{47} = e_i^{47} \times \frac{v_i^{58}}{e_i^{58}} \times \frac{\frac{\bar{v}_i^{47}}{\bar{e}_i^{47}}}{\frac{\bar{v}_i^{58}}{\bar{e}_i^{58}}}$$

where:

e_i : Basin's share of national employment in industry i,

v_i : Basin's share of national value added in industry i,

$\bar{e}_i$: Share of national employment in industry i accounted for by major Basin states,

$\bar{v}_i$: Share of national value added in industry i accounted for by major Basin states.

47 and 58 refer to the years 1947 and 1958.

Remaining Manufacturing Industries (model sectors 14 and 23). For these sectors we determined Basin value-added shares for 1947 by (1) computing the 1958 shares from the special census tabulation prepared for this study by the Bureau of the Census, and (2) adjusting these shares by the 1947-1958 percent changes in the respective value-added shares of the major Basin states. In other words,

$$v_i^{47} = v_i^{58} \times \frac{\bar{v}_i^{47}}{\bar{v}_i^{58}}$$

The special feature of the backward extrapolation used here is that the major changes made in the SIC definition of these two industries between 1947 and 1958 are thus taken into account.

APPENDIX E-3

HOUSEHOLD CONSUMPTION EXPENDITURES

This Appendix offers detailed comments on the formulation of the conversion table which plays a pivotal role in determining the household consumption expenditures column of the base year input-output table as well as the household expenditures component of the Basin's projected gross output level in each industry sector. The conversion table performs two essential and interrelated functions: it translates household consumption expenditures given in terms of national income commodity or service categories into expenditure flows by industry sectors, and it expresses these expenditure flows by industry sectors in producers' values.

In operational terms, the conversion table requires that consumption expenditure data by national income categories be given as data inputs either in absolute dollar terms or in terms of a column of percentages where each percent figure stands for the portion of total consumption expenditures spent on a specific commodity or service group. The conversion table adjusts each data input (there are 52 percentage figures or expenditure categories in our table) for statistical discrepancy, undercoverage or overcoverage, and then allocates each adjusted entry to the industry sectors which absorb that particular item of expenditures in varying amounts. Total consumption expenditures absorbed by a given industry sector can therefore be determined by summing its share of all expenditure items or commodity groups. Then, the table converts the total share of each industry sector, expressed in purchasers' values, into producers' values. Finally, the industry shares are aggregated into the 27-sector industry breakdown of our model.

By necessity, the conversion table imposes the following constraints on our household consumption expenditure projections: (a) constant adjustment coefficients must be applied to current and projected national income data on consumption expenditures by commodity groups (or percent distribution of total expenditures among commodity groups), (b) industry sectors receive a fixed percentage of a certain consumption expenditure total on a given commodity group, and (c) each industry sector always has a constant percent differential between its total share of consumer expenditures expressed in purchasers' values and its total share expressed in producers' values. In addition, the gross margin implied above is allocated to the transportation and trade sectors on the basis of a constant percentage basis, as computed for 1947.

While these assumptions introduce a number of rigidities into the derivation of the base year consumption expenditures column, as well as into our projection framework, it should be recognized that ready-made procedures capable of performing the functions of this conversion table do not exist, and that the alternative to this approach would involve resort to mere intuition.

In formulating the conversion table, two major problems had to be faced. The first involved the reformulation of the 1947 Interindustry Household Allocation Table (Bureau of Labor Statistics, 1947 Interindustry Household Allocations Tabulated by National Income Categories, July 24, 1953). The second problem involved the derivation of a satisfactory method for converting consumption expenditures tallied by producing industries and expressed in purchasers' values into producers' values. These two problems and the methodology used to deal with them are explained in detail below.

1. REFORMULATION OF THE 1947 HOUSEHOLD ALLOCATION TABLE

The table used by the Bureau of Labor Statistics to allocate household consumption expenditures by national income categories into the 200 sectors of the 1947 national model table was reformulated in three respects: by reorganizing it in terms of the commodity or national income categories employed in National Income, 1954 Edition and all the subsequent personal consumption expenditure statistics; by taking into account some expenditure items "omitted" from this allocation table; and by accounting for the commodity-by-commodity discrepancy that appears in the allocation table when compared with similar national income data obtained from National Income, 1951 Edition.

The first problem, i.e., the work of reorganization, involved the aggregation of the expenditure categories used in the 1947 household allocation table (the same classification system as that used in National Income, 1951 Edition) into the expenditure categories subsequently used in National Income, 1954 Edition and in the recent consumption expenditures data given in the Survey of Current Business series. The number of commodity groups or expenditure items is thus reduced in number, since the new classification has fewer entries.

We then accounted for the expenditure items "omitted" from the 1947 household allocation table. These omissions become readily apparent when the expenditure items listed in the household allocation table are compared with the full list of expenditure items given for 1947 in National Income, 1951 Edition.

The consumption expenditure items "omitted" from the 200-sector model household allocation table amounted to about 3.5 percent of the national income personal consumption expenditures total in 1947. Accounting for these

omitted items in our reformulation of the allocation table meant that when the consumption expenditure categories of the 1947 household allocation table were converted into the new classification system, the "omitted" items needed special attention in one of three different ways: (1) a previously omitted item now became a very small part of a sizeable new expenditure category; (2) it formed a considerable portion of the new category; or (3) it reappeared as a separate category. The decision as to how far to carry out special attention with respect to the omitted expenditure items rested on two conditions: (1) that the omitted item or items, after being included in the revised or new expenditure category, should not significantly alter the percent distribution of that expenditure group among the producing industries, and (2) that accounting for the omitted items should not disproportionately widen the gap between the national total of consumption expenditures employed in the 1947 allocation table and the national total given for 1947 in National Income, 1951 Edition. On the basis of these two conditions, we were able to account for about 71 percent of the "omitted" total of $5,780 million.

After reformulating the 1947 household allocation table and accounting for the "omitted" expenditure items, we turned our attention to a final commodity-by-commodity comparison of the reformulated table expenditure totals with those given in National Income, 1951 Edition for the same expenditure or commodity categories. The discrepancies between the two sources for the same consumption expenditure items are apparently due to the fact that the 1947 allocation table totals were based on estimates of individual industry and commodity shipments to the household sector, whereas the national income accounts are based on estimates of how much households spend on particular goods and services. The difference, then, lies at least ostensibly in the simple fact that the two measurements focus upon opposite ends of the distribution-consumption spectrum.

We assumed that this discrepancy between the allocation table totals (as revised and supplemented with the "omitted" expenditure totals) and the national income totals for the same expenditure items will continue to exist, and that national income data must be adjusted slightly upward or downward to compensate for this differential. The adjustment coefficients were then computed by dividing the national income totals by the modified 1947 allocation table totals. These coefficients are then used in the conversion table to adjust the national income estimates of consumption expenditures and to compensate for the measurement discrepancy between the two sources. In almost all instances, however, the effect of this adjustment is minor.

2. CONVERSION OF CONSUMPTION EXPENDITURES FROM PURCHASERS' VALUES INTO PRODUCERS' VALUES

As mentioned earlier, all entries in our base year input-output table are expressed in producers' values. Between purchasers' values and producers'

values lie such margin and spread items as transportation costs, warehousing and storage charges, wholesale and retail trade margins, and Federal, state and local government excise taxes. Since, in our general projection framework, the percent composition of total consumption expenditures in the Ohio River Basin is assumed to be the same as that in the nation, and since the national consumer expenditure data are given in purchasers' values (for the base year as well as the projection years), it becomes necessary to convert the Ohio River Basin tabulations into producers' values. It will be recalled that in our framework this conversion process must take place, for the base year and the projection years, at the stage where consumption expenditures tabulated by the industrial sectors (about 200 sectors) absorbing such expenditures, and where each industry's share is expressed in percentage rather than in absolute terms.

In essence, the process of converting the industry shares (in purchasers' values) into producers' values involves the allocation of the total margin into the transportation, trade, and government sectors. It must be remembered that in input-output analysis, the trade and transportation industries are handled as producing only the value of their services as indicated by their gross margins (i.e., the difference between the selling value and the cost of goods sold). The problem, therefore, for the base year as well as the projection years, is twofold: (1) to convert the consumption expenditure shares of all industries (except transportation and trade) from purchasers' values into producers' values, and (2) to derive the gross margin and allocate it to the trade and transportation industries, as well as to the government sector. In the first case, we must derive producers'/purchasers' value coefficients for 1947 for each industry sector. In the second case, we must estimate the gross margin and the respective shares which transportation, trade and the government sector represent of the total gross margin.

We derived the producers'/purchasers' value coefficients for each industry sector essentially by using the 200-sector Model for 1947. First, from our reformulated version of the 1947 household allocation table we computed the total amount of consumer expenditures absorbed by each industry sector. This was done by adding up each industry's share of expenditures on 52 expenditure groups. Then we compared each industry's total share of consumer expenditures, given in purchasers' values, with the corresponding entry for that industry in the Household column of the 200-sector Model, which is given in producers' values. By dividing the producers' value total for each industry by the purchasers' value total, the producers'/purchasers' value adjustment coefficients for each industry was derived.

In deriving these adjustment coefficients it was found that 9 sectors had adjustment coefficients equal to 1.0000, 110 sectors had coefficients smaller than 1.0000, and 14 sectors had coefficients greater than 1.0000. For about 66 sectors, coefficients could not be derived since they showed no transactions with the household column.

Clearly, the gross margins to be netted out of the second group, in which producers' value totals are smaller than purchasers' value totals, must be allocated to the third group, where producers' value totals are greater than purchasers' value totals.

For 1947, we computed the total gross margin by finding the gross difference between the sum of purchasers' value totals of the industry sectors with coefficients of less than 1.0000 and the sum of their producers' value totals. This turned out to be $35,222.6 million, or about 21 percent of total national consumption expenditures in purchasers' values.

We found that about 80 percent of this gross margin was allocated to five industry sectors belonging to the third group (i.e., with coefficients greater than 1.0000). Specifically, the gross margin was distributed as follows: .02% to EM (Emergency Model) Sector 175, 17.60% to Sector 176, 59.48% to Sector 177, .44% to Sector 212, and 2.36% to Sector 225. We assumed that the remaining 20 percent of the gross margin had already been distributed among the other 9 industry sectors of the third group, where the producers'/purchasers' value coefficients were only slightly in excess of 1.0000.

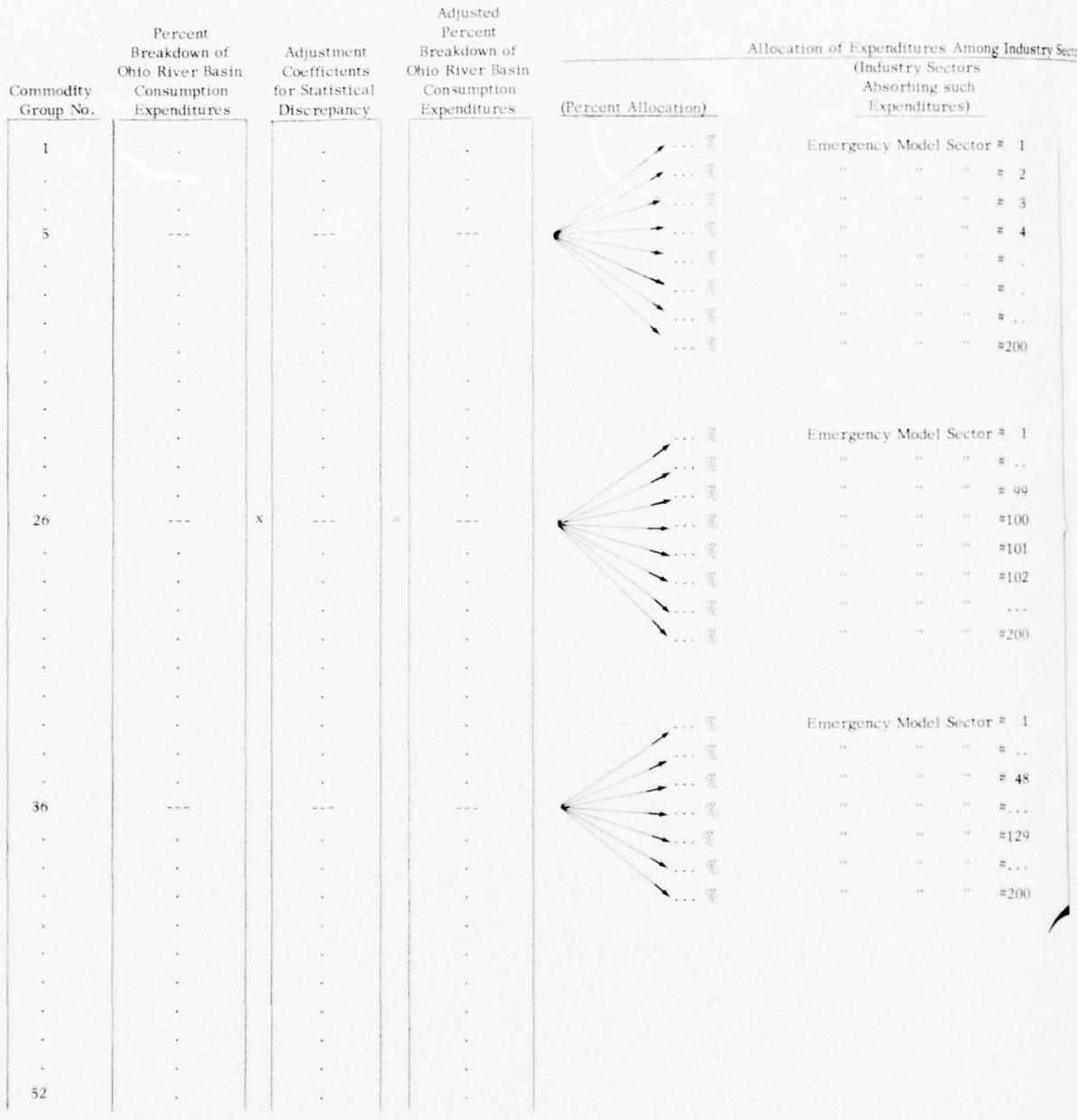
The same procedure was followed for finding and distributing the gross margin in any projection year.

SUMMARY

In computing the base year household consumption column entries, it was first assumed that Ohio River Basin consumption patterns (i.e., the percent composition of total consumption expenditures in terms of commodity or service groups) are the same as those in the nation. The percent composition of consumption expenditures in the nation for 1960 can be determined by using data given in Survey of Current Business (July, 1961). The conversion table is then used to "process" this data so that 27 household proportionality coefficients are obtained. The estimated Basin household consumption expenditures total for 1960 is then multiplied by these coefficients to determine the dollar amount of household consumption expenditures absorbed by each of the 27 industry sectors, in producers' values.

For the projection years, the percent breakdown of total consumption expenditures by commodity or service groups, as projected for the nation in Appendix C, is processed through the conversion table to determine the Basin household consumption proportionality coefficients (c_i), which are then used as projection parameters in the final operating equation (see Chapter III). The operation of the conversion table is shown in diagrammatic form on page E-19.

CONDENSED DIAGRAM



where:

j = Expe

i = Emer
Indus

*For Emergency Model Sectors 175, 176, 177, 212, 225, see text of this Appendix.

**Expenditures absorbed by federal, state, and local governments excluded.

CONDENSED DIAGRAM OF THE CONVERSION TABLE

...try Sectors of the 200-Sector Emergency Model

Expenditures Received by Industry Sectors		Producers'/ Purchasers' Values Adjustment Coefficients*		Expenditures Received by Industry Sectors (in Producers' Values)		Aggregation into 27 Ohio River Basin Industry Sectors (Proportionality Coefficients)				
EM # 1		EM # 1		EM # 1		Ohio River Basin Sector # 1				
.		.		.		.				
.		.		.		.				
.		.		.		.

THE CONVERSION TABLE

el

	Expenditures Received by Industry Sectors		Producers'/ Purchasers' Values Adjustment Coefficients*		Expenditures Received by Industry Sectors (in Producers' Values)		Aggregation into 27 *Ohio River Basin* Industry Sectors (Proportionality Coefficients)		Household Expenditures Column (Ohio River Basin Consumption Expenditures Absorbed by 27 Industry Sectors)**
EM #i =	EM # 1		EM # 1		EM # 1		Ohio River Basin Sector # 1		Ohio River Basin Sector # 1
	.		.		.		.		.
	.		.		.		.		.
	.		.		.		.		.

APPENDIX E-4

GOVERNMENT EXPENDITURES IN THE OHIO RIVER BASIN

INTRODUCTION

A. FEDERAL GOVERNMENT EXPENDITURES IN THE BASIN

1. Purchases of Goods and Services

2. Transfer Payments to Persons

3. Grants-in-aid to State and Local Governments

4. Net Interest Paid

5. Subsidies minus Current Surplus of Government Enterprises

B. STATE AND LOCAL GOVERNMENT EXPENDITURES IN THE BASIN

C. ALLOCATION OF TOTAL GOVERNMENT EXPENDITURES TO THE INDUSTRY SECTORS AND DERIVATION OF PAYMENTS TO HOUSEHOLDS

1. Allocation of Government Nondefense Expenditures to Industry Sectors and Nondefense Payments to Households

2. Allocation of Government Defense Expenditures to Industry Sectors and Defense Payments to Households

INTRODUCTION

Government expenditures on the goods and services produced by the 27 industry sectors in the Ohio River Basin as well as all government payments to households (as income) are recorded in two separate columns in the base year input-output table: (G_1) government nondefense expenditures, and (G_2) government defense expenditures. Government nondefense expenditures include all federal nondefense expenditures in the region, as well as all expenditures of state and local governments including those of cities, counties, townships, school districts and other special districts. Government defense expenditures, on the other hand, include all federal government expenditures on defense, such as payments to military and civilian personnel, outlays on procurement, maintenance and operation of installations and facilities, and construction. This

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Appendix offers a detailed explanation of the derivation of government nondefense and defense expenditures in the Ohio River Basin in 1960, the data problems encountered, and the methodology developed to deal with these problems. For the actual estimate of government expenditures, see Table II at the end of Appendix E-4.

The general methodology followed in determining total defense and nondefense government expenditures in the Basin consisted of three basic steps: (A) determination of total federal government expenditures in the Basin (defense and nondefense combined), compiled and arranged in terms of the national income accounts framework; (B) determination of total state and local government expenditures (all nondefense) in the Basin, similarly compiled and arranged in terms of the national income accounts framework, and (C) rearrangement of the contents of the respective expenditure totals obtained in steps (A) and (B) into government nondefense and government defense expenditure categories, followed by their distribution among the 27 industry sectors and households, always conforming insofar as possible to the methodology used in the 1947 Interindustry Relations Study. Each step will now be treated in detail.

A. FEDERAL GOVERNMENT EXPENDITURES IN THE BASIN

The expenditures of the federal government in the Basin, as compiled and arranged below, conform to the national income accounts definitions of federal government expenditures as reported in the Survey of Current Business, with slight modifications to serve the purposes of this study. It should be stressed that the compilation of federal government expenditures in the Basin, in the format set forth below, comes closest to the input-output definitions and concepts used in the national 1947 Interindustry Relations Study. Thus,

THE SUM OF:

1. Purchases of Goods and Services
   a. Compensation of Employees (excluding government enterprises)
   b. Purchases of Goods and Other Services minus Government Sales
      (i) Defense Outlays for Procurement, Construction, Operation and Maintenance,
      (ii) Nondefense Purchases of Goods and Other Services (construction and other purchases),
2. Transfer Payments to Persons
3. Grants-in-aid to State and Local Governments
4. Net Interest Paid to Persons, Banks, Corporations, and Others
5. Subsidies minus Current Surplus of Government Enterprises

EQUALS: Total Federal Government Expenditures in the Basin

In deriving total federal government expenditures in the Basin in terms of the national income accounts framework given above, extensive use was made of Federal Revenues and Expenditures in the Several States, Averages for the Fiscal Years, 1959-1961, a special study for members of Congress by I. M. Labovitz, Senior Specialist in Social Welfare at the Library of Congress. In addition, we used data from the 1960 and 1961 issues of Governmental Finances, published by the U.S.Department of Commerce.

In the following sections we explain the derivation of Basin totals for each of the five basic expenditure items listed above, the sum of which equals total federal government expenditures in the Basin in 1960.

1. Purchases of Goods and Services

Purchases by the federal government of goods and services in the Basin consist of (a) the compensation of defense and nondefense government employees and (b) purchases of goods and other services for defense and other purposes minus miscellaneous sales by the government.

a. Compensation of Employees

We estimated the compensation of all federal nondefense employees in the Basin by first determining the number of such employees in the Basin part of each state from Additional Report of the Joint Committee on Reduction of Non-essential Federal Expenditures on Federal Civilian Employment by County, a publication of the Congress of the United States pursuant to Section 601 of the Revenue Act of 1941; 87th Congress, 1st Session, December 31, 1960, and then multiplying the total Basin employment obtained in this way by the average annual compensation per federal employee during the years 1959-1961, derived from the Survey of Current Business (July 1963).*

The compensation of federal defense employees in the Basin was derived in a similar manner. First, we estimated the compensation of military personnel by apportioning Labovitz' state totals of "military pay" into the Basin part of each state on the basis of the Basin's percent share of all military personnel in the state. Second, we estimated the compensation of all civilian personnel employed in military departments in the Basin by allocating Labovitz' state totals of civilian pay in military departments between the Basin and non-Basin parts of each state,

*Employees of government enterprises, such as the U.S.Post Office and the Tennessee Valley Authority were omitted from our computations, so as to maintain consistency with the national income accounts definitions.

and then summing the totals for the Basin part of each state. We assumed here that civilian defense compensation in the Basin part of a state is proportional to its share of total civilian defense employment in the state. The latter figure was obtained for each county from the Joint Committee report cited above.

b. Purchases of Goods and Other Services

Separate calculations were made for defense outlays and for purchases of nondefense commodities and other services.

(i) Defense Outlays

We computed the purchases of goods and services for defense purposes by estimating individually the Basin's share of total national defense procurement, construction, and other outlays, as explained below.

Procurement. It is important to note that data on prime military contracts by states do not provide a reliable indication of the actual volume of defense work produced in a given state. For most defense contracts, the data reflect only the location of the plant where the product will be finally processed and assembled. More importantly, only prime military contracts are reported by geographical area, without any breakdown of the location of subcontract activities. In addition, the contract data do not include obligations issued to production establishments operated directly by the military services. For these reasons, state shares in federal military procurement are not reliably represented by their shares of prime military contract awards. To estimate a region's share of total national expenditures on procurement it is therefore necessary to take into account the "defense orientedness" of the region's manufacturing industries. This is, in effect, how Labovitz estimated levels of federal revenues and expenditures by states. He constructed a weighted average to measure: (1) the value of military prime contract awards, which is given a weight of 25; (2) the value added by manufacturing industries, which is given a cumulative weight of 73, with individual defense industries assigned a portion of this cumulative weight; and (3) manufacturing facilities operated by the Department of Defense, which are given a weight of two.

We accepted Labovitz' weighting procedure for our estimates of total procurement expenditures in the Basin. As a first step, we computed the Basin's percentage share of total prime military contract awards in the nation from Awards of Prime Military Contracts by County, State and Metropolitan Area of the United States, Fiscal Year 1960, by Walter Isard and James Ganshow. This share came to 5.31 percent. Second, we computed the Basin's share of national value added for each manufacturing industry, using the 1958 Census of Manufactures and a special census tabulation for the Basin provided by the Bureau of the Census.

Then we weighted the Basin's share of national prime military contracts and the value-added shares in each industry by the appropriate "defense orientedness" weight derived by Labovitz. We decided to ignore the Basin share of manufacturing facilities owned and operated by the Defense Department because their effect on the regional expenditure total appeared negligible. Our estimate of the Basin's share of total national procurement expenditures, as derived by the above process, came to 6.92 percent, or $1,161 million, total expenditures for the 48 contiguous states being $16,783 million (see Labovitz, Table 20).

Construction. From Awards of Prime Military Contracts by County, State and Metropolitan Area, cited above, we obtained the value of construction contracts awarded to firms in the Basin in 1960, and accepted the result as the Basin's total share of national defense construction expenditures.

Operation and Maintenance. We apportioned Labovitz' state-by-state estimates of total military operation and maintenance expenditures into the Basin part of each state on the basis of the Basin's percentage share of total military personnel in the state. Summing these results, we obtained an operation and maintenance total for the Basin.

In summary, the summation of individual Basin totals for procurement, construction, and operation and maintenance yielded an estimate of total federal government purchases of goods and other services for defense in the Basin in 1960.

(ii) Federal Government Nondefense Purchases of Goods and Other Services (minus Government Sales) in the Basin

Before we could compute total federal government nondefense purchases of goods and other services (minus government sales) in the Basin, we had to determine the Basin equivalent of total federal government purchases of goods and services. It will be recalled that total federal government purchases of goods and services consist of (i) compensation of employees, excluding government enterprises, and (ii) purchases of goods and other services (minus government sales), where the latter include "federal government nondefense purchases of goods and other services (minus government sales)." Thus, from our estimate of the Basin equivalent of "total federal government purchases of goods and services" we subtracted the compensation of employees (explained above) and total defense purchases of goods and services (also explained above), in order to determine, as a residual, the total federal nondefense purchases of goods and other services (minus government sales).

2. Transfer Payments

We computed total federal government transfer payments to individuals in the Basin as a residual between (a) total federal nondefense income disbursements to individuals in the Basin and (b) the sum of total federal nondefense disbursements of wages, salaries and interest payments to individuals in the Basin.

We obtained the first figure (total federal nondefense income disbursements) by apportioning Labovitz' state-by-state aggregate estimates into the Basin part of each state on the basis of the Basin's percentage share of total nondefense employment in the state (including Post Office and TVA employees), and summing the Basin totals of the ten states.

Next, we deducted our previously derived estimate of total federal nondefense disbursements of wages and salaries (including wage and salary payments to TVA and Post Office employees) from total nondefense income disbursements. This subtraction yielded the combined total of federal transfer payments and interest payments to individuals in the Basin. This residual was then apportioned into "transfer payments" and "interest payments" by assuming that they bore the same proportional relationship regionally as nationally, using the Survey of Current Business (July 1962) for the national relationship.

3. Grants-in-aid to State and Local Governments

Grants-in-aid to state and local governments are implicitly covered in our estimation of state and local government expenditures, as described in Section B of this Appendix. Therefore, to avoid double-counting, we did not explicitly determine federal grants-in-aid to state and local governments in the Basin in 1960.

4. Net Interest Paid

Interest payments by the federal government include payments to (a) households, (b) banks, (c) corporations and others. Under "transfer payments" we discussed the derivation of interest payments to households in the Basin.

Nationally, Labovitz found that of $4,634 million in total interest payments made by the federal government, about 82 percent was received by banks, 11 percent by the respective state and local governments, and about 7 percent by insurance companies. To determine total interest payments in the Basin (excluding those to households), we apportioned Labovitz' estimate of total payments received by each state between the Basin and non-Basin parts of that state on the basis of bank deposits (i.e., bank deposits in the Basin part as percentage of total bank deposits in the state), and summed the results obtained for the Basin part of all 10 states.

5. Sudsidies Minus Current Surplus of Government Enterprises

Subsidies paid by the federal government fall into three major groups or industry sectors: agriculture, transportation, and the Post Office. To be subtracted from the sum of these payments is the current surplus of government enterprises in the Basin, such as the TVA and the Post Office.

First, we estimated total subsidy payments made to agriculture in the Basin by determining the Basin's share of all federal payments to agriculture. We found that the Basin's weighted share of all federal payments to agriculture in 1960 was 7.76 percent. This was computed by weighting total federal payments to agriculture in the several Basin states (available from the Statistical Abstract of the United States, 1961, Table 865, p. 630) by the percentage shares of the Basin part of total state agricultural employment. We subsequently assumed that the Basin's share of total subsidy payments to agriculture would be the same as this weighted share. Then, from the Survey of Current Business (July 1963), we obtained the amount of subsidy payments made to agriculture in 1960, and multiplied this total by the Basin's share (7.76%) to find total subsidy payments made to agriculture in the Basin.

Next, we estimated that the Basin's share of total subsidy payments to transportation is 7.75 percent, the same as the Basin's share of total allocable federal payments. Finally, we estimated the Basin's share of total subsidy payments to the Post Office at 9.48 percent, the same as the Basin's share of total Post Office Department employment in the nation.

We then approximated the Basin's share of the current surplus of federal government enterprises, to be deducted from the total subsidies received by the Basin. We concentrated on the Post Office and TVA, which are important government enterprises, and ignored the other federal enterprises whose surplus is negligible for the purpose of this study. We assumed that the Basin's share of current surplus in the Post Office Department and TVA is approximately the same as its share of total national expenditures in these two sectors. We thus estimated the Basin's share of total national expenditures at 9.48 percent for the Post Office and 16.01 percent for TVA. Subsequently, we applied these shares to total national current surplus in these two sectors, as reported in the Survey of Current Business (July 1963), to obtain an estimate of the total surplus in the Basin.

B. STATE AND LOCAL GOVERNMENT EXPENDITURES IN THE BASIN

In order to develop state and local government expenditure data for the Basin which would be reasonably consistent with the definitions of the national income accounts and also satisfactory for input-output purposes, we adjusted our estimates of direct state and local government expenditures on the basis of the following reconciliation procedure. The detailed explanation of our derivation procedure follows the outline and the computational steps of the reconciliation format shown here:

Total Direct Expenditures of State and Local Governments (as reported in census-type statistical sources)

Minus:

1. Operating Expenditures and Current Surplus of Utilities and Liquor Stores
2. Operating Expenditures and Current Surplus of other Commercial Activities
3. Unemployment Compensation Benefits
4. Interest Received
5. Purchases of Land and Existing Structures

Plus:

6. Government Contributions to Self-Administered Insurance Funds

Equals:

Total State and Local Government Expenditures (in terms of national income accounts)

In deriving total state and local government expenditures in the Basin, we relied mainly on the 1960 and 1961 issues of Governmental Finances, a publication of the U.S.Department of Commerce. In addition, we used statistics published by the states, counties, cities, school districts, townships, etc., in the Basin, supplemented by data from other federal publications.

The approach consisted of estimating total direct expenditures of state and local governments in the Basin, and of adjusting this total as illustrated above, in order to conform to definitions of national income accounts. In this process, we excluded from consideration the Basin parts of Maryland, North Carolina, and Virginia, since these account for less than 1 percent of total income earned and for only 1-1.5% percent of the Basin's total population in 1960.

On the other hand, we included the entire states of Kentucky and West Virginia, since the Basin parts of these two states virtually coincide with the state boundaries. This procedure was tested for possible distortions in obtaining final Basin totals, and was found to yield the same answers as those obtained by estimating the Basin part of each state in each expenditure category.

Total Direct Expenditures of State and Local Governments

The total direct expenditures of state and local governments comprise all outlays on education, highways, natural resources, health and hospitals, public welfare, police and fire protection, housing and community redevelopment, and many other general government functions.

Two steps were required to determine total direct expenditures in the Basin: (a) derivation of reliable control totals for each state, and (b) apportionment of these control totals between the Basin and non-Basin parts of each state. In the computations required for both of these steps, primary attention was given to the most populous Basin states, Ohio and Pennsylvania, whose Basin parts, in 1960, accounted for about one-half of the region's population. The determination of control totals for these two states presented relatively few problems due to the fact that both states publish rather adequate statistics on the finances of all levels of government. Much effort was spent, however, in apportioning these control totals into the Basin part of either state.

For Pennsylvania, we used a special study showing the county breakdown of most state expenditures. In apportioning other state expenditures, we studied the state budget and made decisions regarding their likely geographic flow, and on this basis determined the amounts spent in the Basin part of the state.

For Ohio, we followed the somewhat simpler approach of using the relative distribution of state employees to apportion state expenditures, and the relative distribution of population to apportion the expenditures of other levels of government.

For the remaining Basin states, reasonably complete and up-to-date statistics were available. Indiana, for example, publishes a fairly complete set of statistics. The most recent data, however, were for the fiscal year 1958-1959, so that control totals from Governmental Finances were used to apportion county and city expenditures to the Basin part of the state. Expenditures of school districts, on the other hand, were apportioned on the basis of the school-age population in the Basin part of the state. Similarly, the expenditures of townships and other local government units were apportioned on the basis of the proportions obtained from the sum of county, city, and school district expenditures. In apportioning state government expenditures, we followed the geographic designations of the state accounts wherever possible, and used the percentage distribution of state employment in the Basin part of the state in all other cases.

For Tennessee, we used the expenditure data given in Governmental Finances, and apportioned the Basin part on the basis of the distribution of state employment and population. In Illinois, we found that about 5 percent of total municipal expenditures were made in the Basin part of the state. We therefore, used a straight 5 percent share in apportioning state and local expenditures to the Basin part of Illinois.

As shown in the reconciliation format at the beginning of this section of the Appendix, the following items had to be subtracted from the direct expenditure total of state and local governments in order to produce a total that is in accord with national income accounts definitions:

1. Operating Expenditures and Current Surplus Utilities and Liquor Stores

In a three-step approach, we first computed total utility and liquor store expenditures in the Basin, then determined total revenues in both, and finally found the net difference between total expenditures and revenues.

Utility expenditures cover the expenditures of government-owned utilities, such as electric power plants, gas systems, water supply systems, transit systems, etc. For Pennsylvania, Ohio and Indiana, we compiled our data exclusively from state publications, whereas for Kentucky and West Virginia, we relied on data given in Governmental Finances. For Illinois, we estimated utility expenditures in the Basin part to be 5 percent of total utility expenditures in the state. In the case of Tennessee, slight adjustments were made in the published state data on utility expenditures by cities and counties, by using Governmental Finances as a guide.

The Basin states which have state liquor stores are West Virginia, Pennsylvania and Ohio. For West Virginia, we used data given in Governmental Finances. For Pennsylvania and Ohio, we were able to obtain total state liquor revenues as well as the revenues in their respective Basin parts. Thus, we apportioned total state expenditures on liquor stores into the Basin part of both states on the basis of the ratio of Basin state liquor store revenues, by assuming a direct relationship between revenues and expenditures.

We then computed total utility and liquor store revenues in the Basin part of each state by making the same assumption as for expenditures; that is, the percent share in revenue of the Basin part of a state was taken to be the same as its percentage share of expenditures. By applying these ratios to total state utility and liquor store revenues available from Governmental Finances, we obtained total revenues in the Basin part of each state. Their sum represents total Basin revenues from state and local government-operated utilities and state-owned liquor stores. It was then possible to calculate the net difference between total Basin expenditures and revenues in these two categories of state and local government activity.

2. Operating Expenditures and Current Surplus of other Commercial Activities

4. Interest Received

5. Purchases of Land and Existing Structures

6. Government Contributions to Self-Administered Insurance Funds

Since the same method was used in estimating the Basin total in each of these categories, they are discussed together. In each case, we estimated that the Basin's percent share of the national total in each category, as reported in the Survey of Current Business, was about 9 percent, the same as the Basin's share of total direct state and local government expenditures for the nation.

3. Unemployment Compensation Benefits

We computed total unemployment compensation benefits in the Basin by apportioning the unemployment compensation total of each state into its Basin part on the basis of the Basin's percentage share of total state unemployment. For Kentucky and West Virginia, we used statewide unemployment compensation data available from Governmental Finances.

In summary, total direct state and local government expenditures in the Basin in 1960 were adjusted to the national income accounts equivalent of total government expenditures by subtracting items (1) through (5) and adding item (6), as outlined in the reconciliation format.

C. ALLOCATION OF TOTAL GOVERNMENT EXPENDITURES TO INDUSTRY SECTORS AND DERIVATION OF PAYMENTS TO HOUSEHOLDS

In Sections A and B we showed the derivation of federal government expenditures and all state and local government expenditures in the Basin. This section explains the allocation of these expenditures to the 27 industry sectors of the model and the payments made to households as personal income. First, however, it is necessary to regroup the expenditures discussed in the previous sections into nondefense and defense categories, as shown in the accompanying tables.

1. Allocation of Government Nondefense Expenditures to Industry Sectors and Nondefense Payments to Households

Government nondefense expenditures consist of all federal nondefense expenditures and the expenditures of all state and local governments in the Basin. Due to slight definitional differences between the national income accounts (which guided our data compilation) and the concepts underlying the 1947 Interindustry Relations Study, we modified our nondefense government expenditures data as follows:

i. Total expenditures are used in the allocations rather than the purchases of goods and services only.

ii. All interest payments are included in payments to households.

iii. Subsidies are included in payments to households.

iv. The Tennessee Valley Authority is treated as a part of the model's industry sector 24 (Transportation, Communications and Utilities). Therefore, such expenditure items as compensation to TVA employees in the Basin are not included in the government nondefense expenditures column.

v. All government enterprises other than the TVA are included in the government nondefense expenditures column.

vi. Government expenditures on education and hospitals, excluding capital outlays, are included in the government nondefense expenditures column, but they are represented as lump sum purchases from education and hospital industries, both of which are classified under the model's industry sector 27 (Services).

Government nondefense expenditures, defined in input-output terms, are presented in Table III. Payments to households are presented in Table V.

Government nondefense expenditures on education and hospitals (excluding capital outlays), and payments to households together comprised about 79 percent of total government nondefense expenditures in the Basin in 1960. The remaining 21 percent was absorbed by the 26 industry sectors in the Basin and by sector 27, which had already been assigned the expenditures on education and hospitals. Allocation to these industry sectors was made on the basis of the percentage distribution of all state and local government expenditures in the 1947 Interindustry Relations Study.

The final distribution of government nondefense expenditures among the 27 industry sectors, households, and other non-industry sectors is given in Table VI.

2. Allocation of Government Defense Expenditures to Industry Sectors and Defense Payments to Households

Government defense expenditures in the Ohio River Basin in 1960, compiled in terms of national income accounts, are presented in Table IV. It will be seen that about 47 percent of the total consisted of payments to households in the form of compensation to civilians in Defense Department establishments and payments to military personnel. The remaining 53 percent consisted of expenditures on procurement, construction, operation and maintenance. No further adjustments or modifications of our estimates for input-output purposes were necessary before allocating them to the 27 industry sectors and to households. Payments to households, moreover, created no allocation problem, since they were estimated for the base year table (see Chapter IV) as a lump sum payment (before taxes) to households in the Basin.

We allocated the remaining defense expenditures (i.e., other than payments to households) among the 27 industry sectors on the basis of the percent share which each industry sector held of total prime military contract awards in the Basin in 1960. This was obtained by means of a series of steps which are explained below.

First, we aggregated the prime military contract awards given by Isard and associates* in 4-digit industry detail into our 27 industry sector framework. Second, we computed each industry's percent share of total contracts awarded in the Basin in 1960 and 1962, and obtained an average of the two (on the assumption that awards for any one year represent work done over varying lengths of time and thus may be subject to spasmodic demands for certain large items). Finally, we used the resulting percentage distribution to allocate our estimate of total defense expenditures (other than payments to households) in the Basin, as shown in Table VII.

Since prime military contract awards represent only the location of the receiving industry and not necessarily the place where the actual work was accomplished, contract awards only partially represent an area's total share of defense expenditures. The implicit assumption in using prime military contract awards in our distribution of defense expenditures, therefore, was that in each industry sector, the same percentage of the total contract work would be executed within the Basin, or vice versa, that in every industry sector, the same percentage of the total contract work would be subcontracted to establishments outside of the Basin. We used these award data because there are no other reliable indices for distributing defense expenditures by geographical area.

*Walter Isard and James Ganshow, Awards of Prime Military Contracts by County, State and Metropolitan Area of the United States, Fiscal Year 1960; and, Walter Isard and Gerald J. Karaska, Unclassified Defense Contracts: Awards by County, State and Metropolitan Area of the United States, Fiscal Year 1962.

TABLE II

TOTAL GOVERNMENT EXPENDITURES IN THE OHIO RIVER BASIN, 1960

	Federal	State and Local	Total
	(Millions of Dollars)		
(National Income Accounts)			
Total Government Expenditures	6,136	4,620	10,756
Purchases of Goods and Services	3,438	3,807	7,245
Compensation of Employees	1,153	2,246	3,399
Other	2,285	1,561	3,846
Transfer Payments	1,914	822[1]	2,736
Net Interest	508	56[2]	564
Subsidies Less Current Surplus of Government Enterprises	276	-65[3]	211
(Other)			
Expenditures of Government Enterprises	401[4]	446[5]	847
Compensation	337[4]	74[5]	411
(Personal Income from Government)			
Total Personal Income	3,892	3,198	7,110
Compensation	1,470[6]	2,320[7]	3,810
Transfer Payments	1,914	822	2,736
Interest	508	56	564

FOOTNOTES TO TABLE II

1. Consists of insurance trust expenditures (mainly unemployment compensation and retirement payments) plus public assistance payments. Public assistance payments were determined from the annual reports of state welfare department and from other state reports. Insurance trust expenditures were computed by using data given in Governmental Finances and in state publications.

2. Estimated at 9 percent of total interest payments by state and local governments in the United States in 1960, the same percentage as the Basin share of total direct expenditures of state and local governments in the nation in 1960.

3. Consists of total current surplus of state liquor stores and local utilities, as explained in the text.

4. Total expenditures of the Post Office Department in the Basin were determined by taking an average of Post Office obligations for the fiscal years 1959-1961, as published in Statistical Abstract of the United States, 1962 (Table 685, p.512), and scaling this national total down to the Basin on the basis of its share of total national Post Office employment (9.48 %). Total expenditures in the Basin by the TVA were estimated, first by averaging its total expenditures for the fiscal years 1960 and 1961 (from the Authority's 1960 and 1961 reports) and, second, by estimating the Basin's share of such expenditures at 16.01 percent, the same as the Basin's share of total TVA employment.

5. Expenditures by government-owned and operated utilities and liquor stores. Compensation was computed by a two-step process. First, we obtained total payrolls in each category for each Basin state for October 1960 from State Distribution of Public Employment in 1960, a publication of the Bureau of the Census. Second, we allocated the monthly state totals into the Basin part of each state on the basis of the Basin's percentage share of total state expenditures in either category. Then, we summed the Basin-part totals for all states and multiplied the resulting Basin total by 12, to obtain a yearly Basin total.

6. Includes the compensation of TVA and Post Office employees.

7. Consists of the total compensation of state and local employees plus the compensation of state liquor store employees and the employees of state and local government-owned utilities.

TABLE III

TOTAL GOVERNMENT NONDEFENSE EXPENDITURES (G_1)
IN THE OHIO RIVER BASIN, 1960
(Federal, State, and Local Government)

		(Millions of Dollars)
Government Purchases of Goods and Services[1] (per National Income Accounts)		7,245
Minus Defense Expenditure (G_2)		2,709
		4,536
Plus Expenditures by		
State and Local Utilities	262	
State Liquor Stores	184	
Post Office Department	376	822
Transfer Payments		2,736
Interest		564
Subsidy Payments		
Agriculture	219	
Transportation	21	
Post Office	59	299
		8,957
Minus Subsidy Payments to Post Office[2] (inclusion would result in double counting)		59
Total Government Nondefense Expenditures		8,898

FOOTNOTES:

1. Includes all payments to education and hospitals, except capital outlays ($2,779.0 million).

2. Since it is implicitly included in the expenditures of the Post Office Department.

TABLE IV

TOTAL DEFENSE EXPENDITURES (G_2)
IN THE OHIO RIVER BASIN, 1960

		(Millions of Dollars)
Households[1]		862
Military Pay	504	
Civilian Pay in Defense Department Establishments	358	
Other		1,847
Procurement Contracts and Construction	1,188	
Operation and Maintenance	659	
Total Government Defense Expenditures		2,709

FOOTNOTE:

1. Before taxes.

TABLE V

GOVERNMENT NONDEFENSE PAYMENTS TO HOUSEHOLDS
IN THE OHIO RIVER BASIN, 1960
(Before Taxes)

		(Millions of Dollars)
Total Compensation of Employees (per National Income Accounts)		3,399
Minus Compensation of Employees		
In Government Defense Sector (G_2)		862
In Education(1)		947
In Hospitals(2)		151
		1,439
Plus Compensation of Employees of State and Local Utilities		
State Liquor Stores		386
Post Office Department		
Transfer Payments		2,736
Interest		564
Subsidy Payments		
Agriculture	219	
Transportation	21	
Post Office	59	299
		5,424
Minus Subsidy Payment to Post Office(3) (inclusion would result in double counting)		59
Government Nondefense Payments to Households		5,365

FOOTNOTES:

1. Compensation of employees in education, as well as total education expenditures (excluding capital outlays), were derived from state data.
2. Compensation of hospital employees was based on hospital payrolls reported in State Distribution of Employment in 1960 and 1961, a publication of the Bureau of the Census.
3. Subsidy payments to the Post Office are implicitly included in the total compensation of Post Office employees.

TABLE VI

DISTRIBUTION OF GOVERNMENT NONDEFENSE EXPENDITURES IN THE OHIO RIVER BASIN, 1960, AND INPUT COEFFICIENTS FOR GOVERNMENT NONDEFENSE INDUSTRY

Model Sector Number	Industry Title	Expenditures (Millions of Dollars)	Input Coefficients (g_i)
1	Agriculture, Forestry & Fisheries	5.81	.00065
2	Coal Mining	13.06	.00147
3	Other Mining (metals, crude oil, minerals)	0.09	.00001
4	Construction	1,228.22	.13803
5	Food & Kindred Products	15.33	.00172
6	Textile Mill Products	0.52	.00006
7	Apparel & Finished Products	11.04	.00124
8	Lumber & Wood Products, Furniture & Fixtures	4.48	.00050
9	Paper & Allied Products	9.63	.00108
10	Printing, Publishing & Allied Products	25.52	.00287
11	Chemicals & Allied Products	12.02	.00135
12	Petroleum Refining	15.82	.00178
13	Rubber & Miscellaneous Products	2.46	.00028
14	Stone, Clay and Glass Products	1.83	.00021
15	Ferrous Metals	0.15	.00002
16	Nonferrous Metals	-	-
17	Fabricated Metal Products	6.19	.00070
18	Machinery, except Electrical	27.93	.00314
19	Electrical Machinery	2.63	.00030
20	Transportation Equipment	1.19	.00013
21	Motor Vehicles	35.95	.00404
22	Tobacco & Leather Products	2.50	.00028
23	Ordnance, Instruments & Miscellaneous Manufacturing	11.61	.00130
24	Transportation, Utilities & Communications	76.39	.00859
25	Trade (wholesale & retail)	4.35	.00049
26	Finance, Insurance & Real Estate	27.09	.00304
27	Services	1,879.06	.21118
	Foreign Trade	1.61	.00018
	Government	110.39	.01241
	Households	5,365.00	.60295
	Gross Domestic Outlays	8,897.87	1.00000

TABLE VII

ALLOCATION OF GOVERNMENT DEFENSE EXPENDITURES
IN THE OHIO RIVER BASIN, 1960

Model Sector Number	SIC	Industry Title	Allocation of Defense Contract Awards[1] 1960	1962	Average	Defense Expenditures in the Basin (Millions of Dollars)
1	01-09	Agriculture, Forestry & Fisheries	.00009	.00005	.00007	0.1
2	11,12	Coal Mining	--	.00617	.00308	5.7
3	10,13,14	Other Mining (metals, crude oil, minerals)	.00009	--	.00005	0.1
4	15,16,17	Construction	.02400	.03323	.02862	52.9
5	20	Food & Kindred Products	.00920	.01864	.01392	25.7
6	22	Apparel & Finished Products	.00039	.00227	.00133	2.5
7	23	Lumber & Wood Products	.00797	.02930	.01864	34.4
8	24,25	Furniture & Fixtures	.00184	.00448	.00316	5.8
9	26	Paper & Allied Products	.00170	.00235	.00202	3.7
10	27	Printing, Publishing & Allied Prod.	.00449	.00725	.00587	10.8
11	28	Chemicals & Allied Products	.02511	.00654	.01582	29.2
12	29	Petroleum Refining	.03759	.01833	.02796	51.6
13	30	Rubber & Miscellaneous Plastics	.00401	.00398	.00400	7.4
14	32	Stone, Clay & Glass Products	.00156	.00211	.00184	3.4
15	331,332,339	Ferrous Metals	.00893	.00843	.00868	16.0
16	333,334, 335,336	Nonferrous Metals	.00482	.00455	.00468	8.6
17	34	Fabricated Metal Products	.00904	.01437	.01170	21.6
18	35	Machinery, except Electrical	.05821	.03341	.04581	84.6
19	36	Electrical Machinery	.08939	.15632	.12286	226.9
20	37 excl.371	Transportation Equipment	.28730	.36919	.32824	606.3
21	371	Motor Vehicles	.06016	.07169	.06592	121.8
22	21,31	Tobacco and Leather Products	.00215	.01133	.00674	12.4
23	19,38,39	Ordnance, Instruments and Misc. Manufacturing	.18336	.04774	.11555	213.4
24	40-49	Transportation, Comm. & Utilities	.01049	.00442	.00746	13.8
25	50-59	Trade (wholesale & retail)	.00641	.00246	.00444	8.2
26	60-67	Finance, Insurance & Real Estate	.00000	.00176	.00088	1.6
27	70-89	Services	.16170	.13962	.15066	278.3
28	99	Nonclassified	.00000	.00000	.00000	--
		Sum of Sectors 1 through 28[2]	1.00000	1.00000	1.00000	1,847.0
		Households				862.0
		Total Expenditures				2,709.0

1. Isard and Ganshow and Isard and Karaska, op.cit.

2. These may not add to total shown because of rounding error.

APPENDIX E-5

INVESTMENT

The derivation of entries for the Investment column of the 1960 Ohio River Basin input-output table is best explained in the following sequence. First we set forth the method for deriving gross private capital formation in the Basin for 1960. Second, we discuss the derivation of Basin inventory levels for 1960. The Investment column is made up of the sum of the two (i.e., gross private capital formation plus inventory changes) for all industry sectors.

GROSS PRIVATE CAPITAL FORMATION

Gross private capital formation consists of expenditures on new private residential and nonresidential construction, producers' durable equipment, and miscellaneous capital charges. In all respects, our definitions conform to those used in the 1947 Interindustry Relations Study; it will be useful, therefore, to clarify some of the important definitions employed.

In the 1947 Interindustry Relations Study, construction is defined as "the design, erection, maintenance and repair of immobile structures and utilities, together with those service facilities which become an integral part of the structure" (National Bureau of Economic Research, Inc., Conference on Research in Income and Wealth, Input-Output Analysis Technical Supplement, 1954, p. 4-5). New construction expenditures by the private sector of the economy are classified as new capital outlays and appear in the final demand section of the table as "gross private capital formation." Expenditures for new public construction, while also a part of the final demand sector, are listed under government purchases. Public maintenance construction was handled in the same manner. Outlays for private maintenance construction, on the other hand, are included in the endogenous or intermediate portion of the table, and as such, are distributed among the industries incurring these expenditures.

For this study we derived total Ohio River Basin construction shipments to the gross capital formation sector for 1947 by assuming that the Basin's percent share of national investment in construction was the same as its percent share of gross national construction output. Next, we updated the estimated 1947 Basin construction investment total to 1960, by assuming that it would have grown at the same rate as the Basin's gross output in the construction industry.

The next step required the computation of the "producers' durable equipment" and "miscellaneous capital charges" components of the Investment

sector. "Producers' durable equipment" covers charges to capital account for outlays by business for machinery and equipment. "Miscellaneous charges to capital account" covers labor and material charges to capital account which cannot be conveniently classified into specified investment categories.

We derived Basin totals of producers' durable equipment and miscellaneous capital charges for 1960 in the way described for private new residential and nonresidential construction. Assuming, first, that the 1947 compilation of producers' durable equipment and miscellaneous capital charges, aggregated into the 27-sector framework of this study, provided the most comprehensive and accurate national compilation of such data for input-output purposes, we derived 1947 Basin totals by assuming further that the Basin's percentage share of producers' durable equipment and miscellaneous capital charges (combined) for each industry sector (except Sector 4, Construction) was the same as its share of national gross output. Second, we assumed that between 1947 and 1960, the combined total of producers' durable equipment and miscellaneous capital charges for each industry sector grew at the same rate as regional gross output in that sector, thus yielding the 1960 Basin estimates.

INVENTORY CHANGES

The inventory component of the Investment column consists of net inventory levels of "finished" products in the industry sectors. This means that net inventory levels may be either negative or positive. In considering net inventory changes in "finished" products only, we are, in essence, complying with the assumption of the 1947 Interindustry Relations Study that changes in inventories of goods in process are negligible (see Input-Output Analysis Technical Appendix, p. 1-25).

In computing Ohio River Basin inventory changes for 1960, we first determined the scalar relationship between the Interindustry Relations Study and the national income net inventory statistics for 1947 for the major industry sectors, by comparing the inventory change columns of the 200-sector table, as aggregated, with the inventory change totals given in U.S. Department of Commerce, National Income 1951 Edition, A Supplement to the Survey of Current Business, p. 200. We then adjusted the national control totals for 1960 available from national income statistics on the basis of these scalar relationships, in order to account for the definitional and coverage differences between the national income accounts and the interindustry analysis concepts. Subsequently, by applying to these adjusted national control totals the Basin's percent shares of national output, we derived net inventory totals by major sectors for the Ohio River Basin. The next task was to allocate the regional control totals for the major sectors among the individual industry sectors contained in the major sectors. This

allocation did not present any problems for the trade sector or the agriculture sector, since these sectors correspond directly to our model industry sectors 25 and 1, respectively.

The "manufacturing" and "all other" control totals, however, required special allocation treatment. The "all other" group, which includes our model industry sectors 2, 3, 4, 24, 26, and 27, was allocated among the component industry sectors on the basis of the percent share which each held of a similar group total in the 200-sector national table.

The "manufacturing" control total was allocated among the individual industry sectors (model sectors 5 through 23) on the basis of the percent distribution of separately derived net inventory levels for the Basin for 1960. These inventory levels were first determined for 1958 (for which year data on Basin value of shipments were available from the special Bureau of the Census tabulation) by assuming that the national inventory/sales ratios also hold for the region. We then updated these net inventory levels to 1960, by assuming that, in 1958-1959 and 1959-1960, inventory changes in the Basin followed the percent increases or decreases in national inventories for the respective industries. Finally, we converted the net inventory levels into percentages (i.e., net inventory level for each industry as a percent of the respective accumulation or depletion total), scaled the accumulation on depletion totals upward so that the net aggregate inventory level would be equal to the "manufacturing" control total mentioned above, and distributed the accumulation and depletion components on the basis of their respective percentage distributions.

APPENDIX E-6

NET TRADE

The net trade column of the Ohio River Basin input-output table records the dollar value of the net flow of goods into or out of the region for each industry sector. Net trade thus constitutes the difference between the value of regional exports and the value of regional imports, expressed in producers' prices. Positive entries represent net exports and negative entries net imports.

By recording the Basin's transactions with the rest of the world, we give explicit recognition to the importance of extra-regional economic forces upon the growth of the Basin. However the measurement of a region's trade transactions is beset by many conceptual and empirical problems. The more "open" the region, the more dependent it is on growth determinants outside of the region and the more important it becomes to measure these economic relationships, even though the procedure is fraught with practical difficulties.

Theoretically, the imports and exports of an open region are among the "prime movers" of the economy. In recent years, the causal relationships between a region's "export" and "non-export" industries have been the subject of extensive study and discussion. Without engaging in the argument, it is clear that the Basin's overall economic development is strongly influenced by extra-regional factors since it depends to a significant degree on imports from and exports to other regions.

The two principal data sources available for computing a region's import-export relationships are (1) the one percent sample waybill data published by the Interstate Commerce Commission on state-to-state shipments of individual commodities and groups of commodities by Class I railroads, and (2) the data published by the Corps of Engineers, U. S. Army, on waterborne shipments of commodities into and out of U. S. ports.

For the purpose of this study these data sources could not be used, however, because they are limited to state-to-state commodity movements and because the ICC commodity classification code cannot be completely reconciled with the Standard Industrial Classification system of the Bureau of the Budget. Besides, data on shipments by highway carrier (a rapidly growing mode of commodity transport) are even less adequate. For these reasons we had to seek other means of quantifying the Basin's imports and exports.

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To make a preliminary identification of a region's export and non-export industries, location quotients are frequently used. Expressed either as a ratio or as a pure number, the location quotient (see Chapter IV for definition) is computed as follows:

R_i: number of employees in industry i in the region,

R : number of employees in all industries in the region,

N_i: number of employees in industry i in the nation,

N : number of employees in all industries in the nation,

$$\frac{R_i/N_i}{R/N} \quad \text{or} \quad \frac{R_i/R}{N_i/N}$$

(Other units of measurement, such as value added, income originating, etc., may be used, depending on the purpose of the study.)

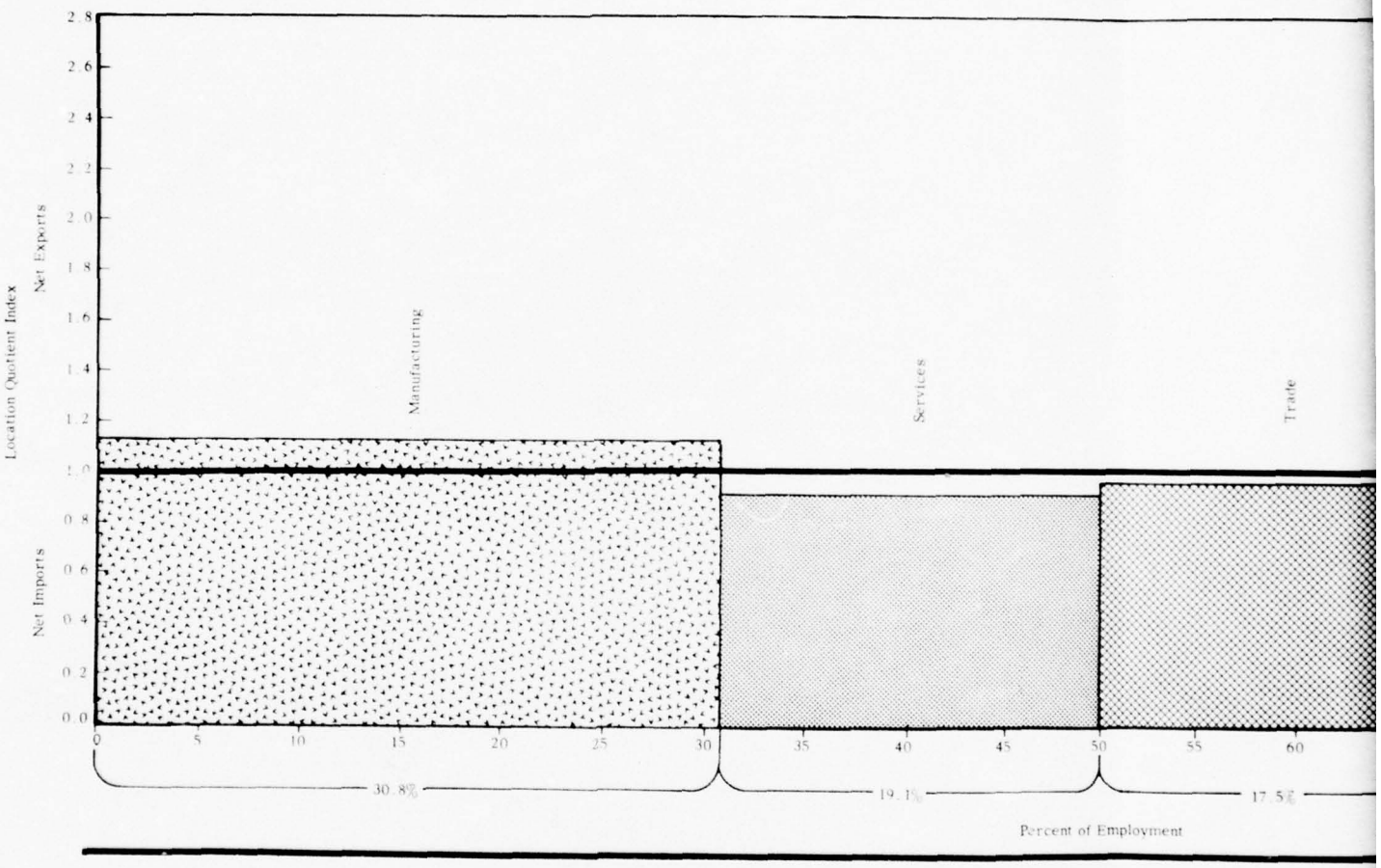
The industries for which the location quotient exceeds unity (i.e., 1.0000) are then recognized as the region's export industries (see Figure 5).

The use of location quotients for anything but an initial identification of export industries should be avoided, however, because of the technique's many limitations. Some of these shortcomings are cited by Isard,* and many others can be added to the list.**

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*Walter Isard, et. al., Methods of Regional Analysis: An Introduction to Regional Science (New York: The Technology Press of M.I.T. and John Wiley and Sons, Inc., 1960), p. 108.

**The method contains implicit assumptions concerning areal or regional uniformity of the earnings of the factors of production, production functions, economies of scale, and patterns of consumption. In addition, it assumes that no products are exported by an industry until local needs are met, and that goods produced by a given industry are homogeneous. See, Otis D. Duncan, et. al., Metropolis and Region (Baltimore: The Johns Hopkins Press, 1960), p. 209.



OHIO RIVER BASIN LOCATION QUOTIENTS--PRINCIPAL IN
(Based on Employment Data from 1960 Census of Po



IVER BASIN LOCATION QUOTIENTS--PRINCIPAL INDUSTRY SECTORS
(Based on Employment Data from 1960 Census of Population)

FIGURE 5

Because of these limitations, we decided to compute trade coefficients for the Ohio River Basin study in a new way. Our method rested on a procedure in four steps: (1) computation of a weighted consumption share for each of the Basin's industry sectors (i.e., the Basin's total consumption of an industry's output expressed as a percent of total national consumption of the same industry's output); (2) computation of the Basin's production share for each industry; (3) computation of the difference between the Basin's consumption share and its production share of each industry (expressed as a percent of the Basin's national production share); and (4) determination of Basin exports or imports for each industry by multiplying the percent factor derived in step (3) by the total gross output of each of the Basin's industry sectors. If the Basin's consumption share exceeds its production share in a given industry sector, then the industry is said to be a net importer. If, on the other hand, the production share exceeds the consumption share, the industry is identified as a net exporter.

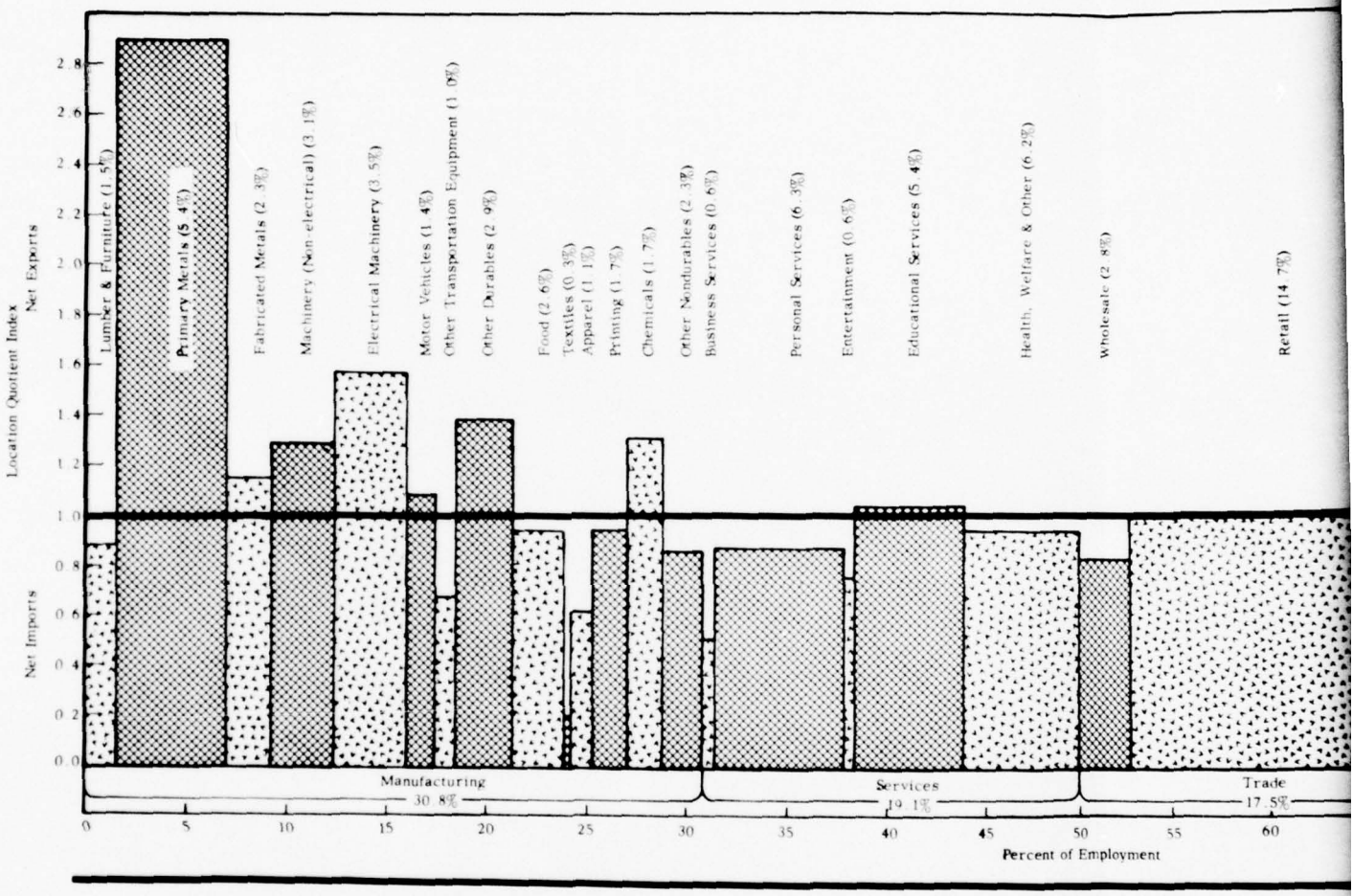
As an initial screening procedure, net export and net import industries were identified by location quotients (see Figure 6). The following two criteria were established to single out the export industries:

1) The industry should account for at least 1% of total employment. (We used 1.1% to offset rounding errors.)

2) The industry should have a location quotient in excess of unity. (For the computations, we set the minimum at 1.15 to offset possible rounding errors.)

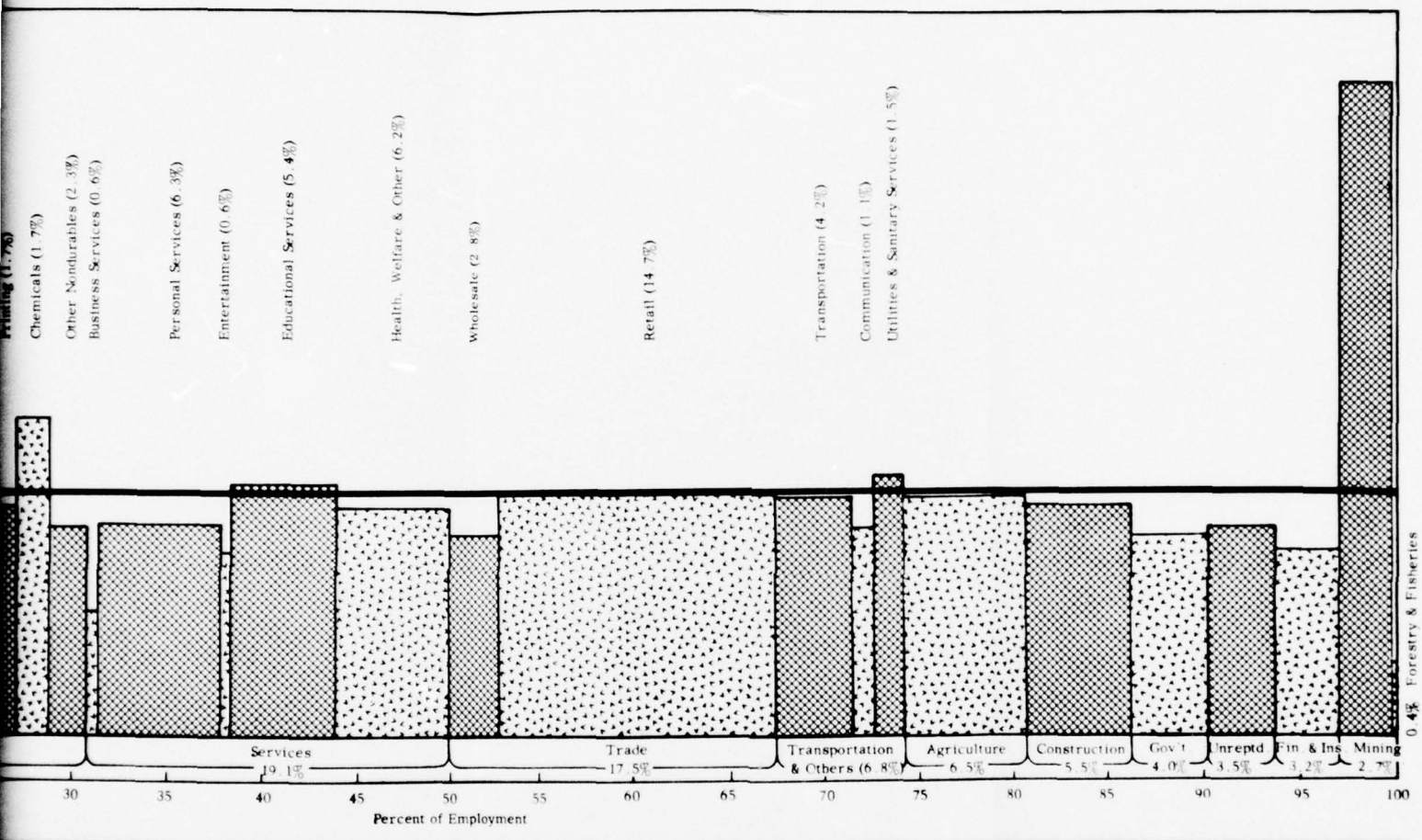
By this process of elimination we were able to make a preliminary identification of the following regional export industries in 1960:

Model Sector No:	Industry
2	Coal Mining
11	Chemicals and Allied Products
14	Stone, Clay, and Glass Products
15	Ferrous Metals (Iron & Steel)
17	Fabricated Metal Products
18	Machinery, except Electrical
19	Electrical Machinery



OHIO RIVER BASIN LOCATION QUOTIENTS--DETAILED IND

(Based on Employment Data from 1960 Census of P



RIVER BASIN LOCATION QUOTIENTS--DETAILED INDUSTRY BREAKDOWN

(Based on Employment Data from 1960 Census of Population)

FIGURE 6

2

Having identified the potential export industries by means of the location quotient method, we then proceeded to confirm this selection by using the trade coefficient computations outlined on the preceding page and to quantify the Basin's export and import volumes in 1960. A detailed explanation of the computation method follows:

The weighted consumption shares for the Basin were derived by multiplying the 1947 percent distribution of the national output of a given industry sector among its purchasers (i.e., sales to intermediate and final demand sectors) by the Basin's percent shares of national production in all of these industries and the final demand sectors, summing the results, and then dividing the sum by 100. An illustration of this computational procedure (and of its relation to the subsequent steps) is offered on the following page for Sector 1 - Agriculture, Forestry, and Fisheries.

Repeating this computation procedure for all the industry sectors, we obtained an initial set of estimates of the Basin's net trade with the rest of the world. As pointed out in the text, these initial estimates were later slightly revised in the process of reconciling the sum of independently determined final demand sectors and the intermediate demand column with the Basin's estimated gross output levels. Since the sum of an industry's sales to other industries for intermediate consumption (intermediate demand) and to the final demand sectors must be equal to that industry's previously computed gross output, the discrepancy between the two must be due to overestimations or underestimations in one or more of the demand sectors. We decided that overestimations or underestimations were most likely to occur in the intermediate demand and the net trade totals, and we therefore proceeded to distribute the discrepancy between these two columns. The resulting adjustments in the intermediate demand and net trade totals were quite minor in most cases and did not substantially change the initial totals.

Table VIII presents the final trade coefficient estimates for 1960, together with the initial set of estimates and the location quotients. It should be noted that in all cases the preliminary identification of export and non-export industries using location quotients was fully confirmed by the results of the trade coefficient derivation, as described above.

Ohio River Basin Sector No. (1)	Basin's % Share of Total U. S. Output Levels, etc. (1960) (2)		Agriculture, Forestry, & Fisheries: % Distribution of Sales in 1947 Among Consuming Sectors (200-sector table aggregated) (3)		Product (2) x (3) (4)
1	9.71%	x	25.39	=	246.5369
2	66.44	x	-	=	-
3	7.46	x	-	=	-
4	9.29	x	.23	=	2.1367
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27	9.14	x	.29	=	2.6506
Government	8.08	x	.45	=	3.6360
Inventory	9.71*	x	-	=	-
Gross Capital Formation	12.14**	x	.05	=	.6070
Households	10.65	x	24.08	=	256.4520
TOTAL			100.00%		944.3520

1) Weighted Basin consumption share of U. S.	9.44%
2) Basin output share of U. S.	9.71%
3) Difference between Basin's output share and consumption share	.27
4) Basin exports or imports as percent of its output share	2.78%
5) 1960 Basin gross output in Sector #1 (Agriculture, Forestry, & Fisheries)	$4510.4 mil.
6) Total Basin exports in this sector	$ 125.4 mil.

NOTES: *Same as Basin's output share in Sector #1 - Agriculture, Forestry, and Fisheries.

**Found by estimating Basin's percent shares of national capital expenditures in manufacturing and nonmanufacturing sectors, and by weighting them by the percentage composition (manufacturing, nonmanufacturing) of total Basin employment.

TABLE VIII

OHIO RIVER BASIN NET TRADE, 1960

Sector No.	Industry Title	Initial Derivation of Trade Coefficients: Basin's % Share of National Consumption (1960) (1)	Basin's % Share of National Output (1960) (2)	Difference -: Imports +: Exports (3)	Net Trade as % of Basin's Output Share (1960) (4)	Basin's Gross Output ($ millions) (1960) (5)	Basin's Imports (-) or Exports (+) ($ millions) (1960) (6)	Final Derivation of Trade Coefficients: Basin's % Share of National Consumption (7)	Net Trade as % of Basin's Output Share (rounded) (8)	Basin's Imports or Exports - Final - ($ millions) (9)	Location Quotients (10)
1	Agriculture, Forestry, & Fisheries	9.44	9.71	.27	2.78	4510.4	125.4	9.46	2.60	117.2	.98
2	Coal Mining	11.01	66.44	55.43	83.43	1391.1	1160.6	10.89	83.60	1163.0	6.53
3	Other Mining (metals, crude oil, minerals)	9.89	7.46	-2.43	-32.57	1066.7	-347.4	9.85	-32.10	-342.4	.73
4	Construction	10.56	9.29	-1.27	-13.67	7174.1	-980.7	9.98	-7.40	-530.5	.93
5	Food & Kindred Products	10.22	9.49	-.73	-7.69	6390.9	-491.5	9.97	-5.04	-321.9	.92
6	Textile Mill Products	5.95	1.80	-4.15	-230.56	232.3	-535.6	5.56	-208.69	-484.8	.17
7	Apparel & Finished Products	9.53	4.22	-5.31	-125.83	696.9	-876.9	9.96	-135.96	-947.5	.53
8	Lumber & Wood Products, Furniture & Fixtures	10.01	8.27	-1.74	-21.04	1185.3	-249.4	9.82	-18.71	-221.8	.82
9	Paper and Allied Products	8.94	7.30	-1.64	-22.47	1246.9	-280.2	9.27	-26.98	-336.4	.79
10	Printing, Publishing & Allied Products	9.21	8.61	-.60	-6.97	1308.5	-91.2	9.16	-6.37	-83.4	.95
11	Chemicals and Allied Products	11.84	12.51	.67	5.36	3920.8	210.2	11.80	5.68	222.7	1.29
12	Petroleum Refining	10.15	6.03	-4.12	-68.33	1000.4	-683.6	9.68	-60.58	-606.0	.59
13	Rubber & Miscellaneous Plastics	10.88	10.64	-.24	-2.26	834.4	-18.9	10.83	-1.75	-14.6	1.05
14	Stone, Clay & Glass Products	12.57	19.90	7.33	36.83	2270.9	836.4	11.98	-39.81	904.1	2.30
15	Ferrous Metals	19.46	31.90	12.44	39.00	8348.9	3256.1	19.82	37.88	3162.7	3.15
16	Nonferrous Metals	13.73	13.17	-.56	-4.25	1284.8	-54.6	13.83	-5.00	-64.2	1.38
17	Fabricated Metal Products	11.52	14.18	2.66	18.76	3370.9	632.4	11.22	20.88	703.9	1.37
18	Machinery, except Electrical	12.49	13.19	.70	5.31	4029.9	214.0	12.26	7.06	284.7	1.30
19	Electrical Machinery	12.84	18.62	5.78	31.04	4504.0	1398.0	13.35	28.28	1273.9	1.63
20	Transportation Equipment	9.74	7.07	-2.67	-37.77	1469.7	-555.1	8.11	-14.76	-216.9	.68
21	Motor Vehicles	11.12	11.49	.37	3.22	3347.1	107.8	11.11	3.27	109.6	1.14
22	Tobacco and Leather Products	10.98	11.90	-.92	-7.73	1209.0	-93.5	12.36	-3.89	-47.0	.83
23	Ordnance, Instruments & Misc. Mfg.	9.42	4.23	-5.19	-122.70	749.1	-919.1	8.14	-92.51	-693.0	.51
24	Transportation, Communications & Utilities	10.56	9.83	-.73	-7.43	6432.9	-478.0	10.40	-5.82	-374.2	.99
25	Trade (wholesale & retail)	10.56	9.61	-.95	-9.89	10,090.0	-997.9	9.92	-3.20	-322.5	.96
26	Finance, Insurance & Real Estate	10.27	7.64	-2.63	-34.42	8757.5	-3014.3	9.86	-29.12	-2550.4	.76
27	Services	10.07	9.14	-.93	-10.18	8869.3	-902.9	9.97	-9.06	-803.4	.91

NOTES:

Column (1): See accompanying text for explanation.

" (2): See Appendix E-1 for explanation.

" (3): Column 2 minus column 1.

" (4): Column 3 as percent of column 2.

" (5): Refer to base year input-output table (Chapter IV).

" (6): Column 4 multiplied by column 5.

" (7): This is what the Basin's weighted consumption share would be after final reconciliation adjustments on Basin exports and imports in each industry sector.

" (8): The difference between the Basin's final weighted consumption share and output share (same as column 2) as percent of column 2.

" (9): Equivalent to column 8 times column 5. Found by slightly increasing or decreasing the initial import and export estimates given in column 6, so as to achieve a balance between the sum of the intermediate and other demand totals and the gross output total for each industry.

" (10): Location quotients for the manufacturing sectors are computed by using employment data from a special tabulation of the 1958 Census of Manufactures made available by the Bureau of the Census. Coal Mining (#2) and Other Mining (#3) location quotients are based on employment data from the 1958 Census of Minerals. All other location quotients are based on employment data from the 1960 Census of Population. Location quotient for #1 (Agriculture, Forestry and Fisheries) is computed for Agriculture only.

APPENDIX E-7

PRIMARY AND NON-PRIMARY INPUTS

Operational definitions of primary and non-primary inputs are given in Chapter IV. This Appendix discusses the computational procedures followed in deriving the base year values. As indicated in the text, non-primary input totals for each of the 27 industry sectors were obtained as residuals, by subtracting the primary input total of each industry sector from its total gross inputs (gross outputs). We can, therefore, confine ourselves to the derivation of primary inputs for the base year.

Primary inputs are recorded in the base-year table in two rows: (a) household or personal income accruing to individuals from each industry during the base year, and (b) miscellaneous charges against final product, including (i) depreciation and other capital consumption allowances, (ii) payments to federal, state, and local governments, (iii) retained earnings, and (iv) unallocated charges against final product. While personal income in the Basin could be computed directly from available data, the values for miscellaneous charges had to be computed indirectly, since reliable data do not exist for this purpose. The 1960 equivalent of each industry's total primary inputs (payments to households as personal income plus miscellaneous charges against final product) was therefore indirectly approximated and the corresponding personal income total was subtracted from it to yield, as a residual, each industry's total miscellaneous charges against final product.

PERSONAL INCOME

As recorded in the base year table, personal income consists of industry wage and salary disbursements, other labor income (dividends, net interest, claim payments, contributions to private pension plans, royalties, etc.), proprietors' income, property income, and transfer payments exclusive of social security payments to government.

The determination of personal income originating from each industry sector involved two basic steps. In the first step, we approximated personal income originating in each major industry sector in the region (i.e., agriculture, coal mining, other mining, construction, manufacturing, wholesale and retail trade, finance-insurance-real estate, transportation-communications-utilities, services, and government). In the second step, we distributed personal income originating in manufacturing among the individual manufacturing industry sectors.

Personal income originating in each major sector in 1960 is available by state from U.S. Department of Commerce, Survey of Current Business (August 1963), pp. 10-14. Since the Basin covers parts of several states, we weighted personal income originating from each major industry sector in each state by that industry's employment share in the Basin part of the state using share estimates derived from 1960 Census of Population data. By summing the results for all the Basin portions of the relevant states, we obtained total income originating in each major industry sector for the region as a whole.

Regional personal income originating in the manufacturing sector was then further distributed among the industries which make up the manufacturing sector on the basis of the percentage distribution of total Basin payrolls. Payroll figures for each industry by states can be found in the 1960 Annual Survey of Manufactures. To estimate each industry's payroll totals in the Basin parts of the relevant states, the previously noted weighting scheme was used again. By summing the results for all the Basin portions of the relevant states, we obtained total payrolls in each manufacturing industry for the region as a whole. Next, by converting these payroll totals into percentage terms (i.e., each industry payroll as a percent of the total regional manufacturing payroll) and applying them to total regional personal income originating in the manufacturing sector as a whole, personal income originating in each of the individual manufacturing industry sectors was obtained.

MISCELLANEOUS CHARGES AGAINST FINAL PRODUCT

We obtained each industry's total miscellaneous charges against final product by an indirect process which consists of two steps: First, we determined the 1960 equivalent of each industry's total primary inputs by (i) updating to 1960 the 1947 national primary inputs of the major industry sectors* by means of growth indexes of gross product originating (1960/1947),** (ii) scaling them down to the

*Consisting of agriculture, coal mining, other mining, construction, manufacturing, transportation-communications-utilities, wholesale and retail trade, finance- insurance-real estate, and services.

**Gross product originating growth indexes for the 1947-1960 period can be derived from data in the Survey of Current Business (October 1962 and September 1963). Gross product originating, as defined in national income accounts, corresponds closely to the concept of industry payments to households and government, as defined in the 1947 Interindustry Relations Study. GPO represents the amount by which an industry's total product (measured at market value and therefore including indirect business taxes, such as excise, property and sales taxes) exceeds the value of the materials and services which it buys on current account. Since our objective was to derive for 1960 primary input totals for each industry sector which would conform to the 1947 Interindustry Relations Study household and government row entries (where primary inputs are listed in greater detail than in the definition of GPO), it was decided to use GPO data in the form of indexes rather than as equivalents of primary input totals.

Basin level by applying to them the region's percent share of total national output in 1960 in each of these major sectors, and (iii) further distributing the regional primary input total of the manufacturing sector among the individual industry sectors that comprise it.*** Second, we subtracted from these primary input totals each industry's personal income payments to households (as previously determined), in order to obtain, as residuals, each industry's total miscellaneous charges against final product in 1960.

BALANCING THE INPUT-OUTPUT TABLE

As was explained in Chapter IV, an input-output table requires that the sum of the primary input row totals be equal to the sum of the final demand columns. Operationally, it would have been extraordinary if the independently and individually derived final demand sector totals and the primary input row totals had agreed on the first try. In this study, we found that the sum of the final demand sector totals exceeded the sum of the primary input row totals. Since the final demand sectors and the intermediate demand sector had already been reconciled, and in view of the fact that the derivation of household income was based on comprehensive and up-to-date data, it was decided to lower the values in the row showing miscellaneous charges against final product in order to achieve a balance. In this manner, adjustments for statistical discrepancies were made in the component whose values had been derived by the most indirect method.

***We distributed the primary inputs of the manufacturing sector into the individual industry sectors comprising it on the basis of each industry's 1960 value-added share of total manufacturing value added in the region.

APPENDIX F

DERIVATION OF PROJECTION PARAMETERS

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APPENDIX F

DERIVATION OF PROJECTION PARAMETERS

Appendix F is an extension of Chapter IV (Section B, Part 2) which explains the derivation of the projection parameters used in the computer simulation of the regional economic system for each of the benchmark years of the 50-year projection period.

As noted in Chapter IV, the computer solution of the model requires gross output projections to be determined first, i.e., before any of the projections (e.g., personal income, intermediate demand totals of all industry sectors, household consumption expenditures expressed as flows into industry sectors) can be made. The parameters used in the computer solution of projected gross output levels are listed in the final working equation of Chapter IV (Section B, Part 3: Computer Solution of the Model). For purposes of clarity, each of these parameters will now be discussed in the context of the various demand components of gross output--intermediate demand, household consumption, government purchases, investment, etc.--in the sequence in which they were presented in Chapter IV.

1. INTERMEDIATE DEMAND

Total intermediate demand in the Basin is projected by means of the relationship $X_{iN} = \bar{a}_{iN} + \sum_j a_{iN} a_{Nj} X_j$, where $\bar{a}_{iN}$ and a_{iN} represent, respectively, the intercept and slope of the linear function which relates an industry's intermediate demand total (i.e., total shipments to all other industries) to the sum of intermediate demand totals of all industry sectors. The last parameter, a_{Nj}, is simply the 1960 proportionality coefficient obtained by dividing the non-primary input total for each Basin industry by the industry's total gross inputs (or gross output). The attached table gives these three parameters for each of the 27 industry sectors.

The final determination of the intermediate demand total for each industry sector must await the model generation of gross output levels. Then, by substituting the projected gross output levels for X_j, and using them together with the three parameters described above as inputs into a program coded in FORTRAN, the intermediate demand total (X_{iN}) for each industry is obtained with the aid of an IBM 1401.

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TABLE I

INTERMEDIATE DEMAND PARAMETERS
(fixed for the projection period)

Model Sector No.	$\bar{a}_{iN}$	a_{iN}	a_{Nj}
1	3673.8	-0.011443	.600368
2	0.0	.004065	.242111
3	98.2	.025028	.274866
4	-1170.4	.068828	.630434
5	96.0	.062435	.749847
6	83.1	.008499	.621180
7	60.7	.002342	.606400
8	167.0	.017148	.627689
9	- 76.4	.030126	.670543
10	- 74.7	.021692	.470462
11	-1097.9	.083301	.620690
12	125.2	.013602	.856557
13	- 128.0	.015711	.601390
14	113.3	.022047	.523229
15	3657.2	.023031	.672424
16	241.2	.020273	.682441
17	- 73.8	.047737	.615207
18	- 157.0	.039074	.569865
19	- 765.8	.045097	.572003
20	- 238.2	.019478	.553514
21	- 497.1	.038783	.771862
22	- 61.3	.014535	.718445
23	- 168.9	.016432	.578160
24	- 316.1	.097824	.373113
25	-1329.0	.094257	.365025
26	-1475.3	.108401	.362935
27	- 685.8	.071697	.373073
	$\Sigma = 0$	$\Sigma = 1.000000$	

2. HOUSEHOLD CONSUMPTION EXPENDITURES

The projection of household consumption expenditures on the goods and services of each industry sector involves, first, the projection of household consumption proportionality coefficients (c_i) for each of the projection years, and second, the projection of total household consumption expenditures in the Ohio River Basin for each projection year. The function of the proportionality coefficients (c_i) is to apportion among the individual industry sectors projections of total household consumption expenditures in the Basin.

In deriving the household consumption proportionality coefficients, we first projected the composition of consumption expenditures in the nation by 52 commodity or service expenditure groups, as explained in Appendix C. We then assumed that the percentage composition of household consumption expenditures would be the same in the Basin as in the nation. With the aid of the conversion table described in Appendix E-3, we converted the percentage composition of consumption expenditures by commodity or service groups into proportionality coefficients.

Household consumption expenditures on the goods and services of each of the 27 industry sectors is given by the following equation, where the entries on the right-hand side (except c_i, the proportionality coefficient) describe total consumption expenditures in the Basin.

$$c_i = \left[\frac{\sum_j h_j (1 - a_{Nj}) X_j + Y_{G2}}{1 - p\gamma} \right] \cdot \beta_{US} \cdot \alpha_{US} \cdot c_i$$

All parameters in this equation are identified and explained in Chapter IV (Section B, Part 2). The values of these parameters are given in Tables II, III and IV.

As mentioned previously, regional consumption expenditure projections cannot be made until gross output levels for the region are derived from the model. Then, using the projected gross output levels and the parameters shown in the equation above and presented in the accompanying tables as inputs into a computer program, household consumption expenditure flows to each of the 27 industry sectors are determined for each projection year.

TABLE II

HOUSEHOLD CONSUMPTION PROPORTIONALITY COEFFICIENTS, (c_i)
1960 - 2010

Model Sector No.	1960	1970	1980	1990	2000	2010
1	.03998	.03658	.03343	.03275	.03068	.03044
2	--	--	--	--	--	--
3	.00070	.00069	.00069	.00069	.00069	.00061
4	.00087	.00088	.00088	.00088	.00088	.00088
5	.10788	.10178	.09465	.09270	.08977	.08805
6	.00616	.00587	.00583	.00528	.00530	.00503
7	.04602	.04500	.04305	.04278	.04244	.04202
8	.00931	.00964	.01026	.01031	.01075	.01083
9	.00228	.00240	.00240	.00243	.00244	.00246
10	.01060	.01026	.00944	.00881	.00884	.00891
11	.01454	.01536	.01594	.01681	.01701	.01713
12	.02336	.02717	.02881	.03087	.03207	.03310
13	.00546	.00492	.00467	.00465	.00464	.00463
14	.00135	.00106	.00090	.00073	.00062	.00038
15	--	--	--	--	--	--
16	.00017	.00017	.00017	.00017	.00017	.00017
17	.00420	.00406	.00378	.00377	.00349	.00333
18	.00312	.00333	.00345	.00357	.00358	.00361
19	.01071	.01202	.01261	.01325	.01369	.01380
20	.00227	.00275	.00307	.00334	.00342	.00352
21	.02910	.03417	.03658	.03879	.04033	.04129
22	.01719	.01480	.01241	.01144	.01015	.00987
23	.01555	.01606	.01706	.01731	.01736	.01756
24	.06316	.04542	.04336	.04167	.04163	.04162
25	.20862	.20860	.20510	.19960	.19799	.19563
26	.22812	.25625	.27656	.28644	.29272	.29678
27	.14216	.13312	.12776	.12419	.12242	.12105

TABLE III

HOUSEHOLD CONSUMPTION EXPENDITURE PROJECTION PARAMETERS FOR MODEL INDUSTRY SECTORS

Model Sector No.	Proportion of Gross Product Originating Going to Households (h_j)	Proportion of Gross Product Originating Going to Others ($1-a_{Nj}$)
1	.590680	.399632
2	.709665	.757889
3	.111441	.725134
4	.603138	.369566
5	.602052	.250153
6	.879545	.378820
7	.944951	.393600
8	.880127	.372311
9	.729796	.329457
10	.838216	.529538
11	.486417	.379310
12	.456446	.143443
13	.686109	.398610
14	.719405	.476771
15	.763501	.327576
16	.692402	.317559
17	.762624	.384793
18	.781008	.430135
19	.718940	.427997
20	.777050	.446486
21	.841016	.228138
22	.463278	.281555
23	.742089	.421840
24	.646862	.626887
25	.785840	.634975
26	.848865	.637065
27	.657633	.626927

TABLE IV

HOUSEHOLD CONSUMPTION EXPENDITURE PROJECTION PARAMETERS FOR BENCHMARK YEARS

Benchmark Years	Y_{G2} (millions of 1960 dollars)	γ (gamma)	β_{US} (beta)	α_{US} (alpha)	p
1960 Base Year	862.0	.24	.90243	.92733	.60295
1970	1,419.2	.24	.89992	.91879	.60295
1980	2,360.6	.25	.89349	.91176	.60295
1990	3,124.0	.28	.88658	.90646	.60295
2000	3,941.5	.31	.87927	.90211	.60295
2010	5,446.1	.33	.87234	.89860	.60295

NOTE:

For clarification of column headings, see Chapter III.

3. GOVERNMENT EXPENDITURES

While the projection of government nondefense expenditures in the Ohio River Basin is functionally related to levels of regional personal income, government defense expenditures in the Basin are independently or exogenously projected. Both types of projections are explained below.

a. Government Nondefense Expenditures

The functional relationship between government nondefense expenditures and total regional personal income is defined by:

$$G_1 = \gamma \left(\frac{\sum_j h_j (1 - a_{Nj}) X_j + Y_{G2}}{1 - p\gamma} \right)$$

where γ (gamma) is a varying proportionality coefficient and all the terms in the parenthesis represent total regional personal income. Government nondefense expenditures on the products of each of the 27 industry sectors can then be found by multiplying the projected nondefense expenditures total (G_1) by allocation coefficients (g_i) which represents each industry's share of total government nondefense expenditures in 1960.

As was the case for the intermediate demand and the household consumption expenditure projections, gross output levels had to be determined before government nondefense expenditures could be projected. The projected gross output levels, the allocation coefficients (g_i), and the other parameters contained in the equation above were then used as inputs into a computer program and solved on an IBM 1401, to determine government nondefense expenditures on the products of each of the 27 industry sectors for any projection year. All projection parameters contained in the above equation are presented in Tables III and IV. For the allocation coefficients (g_i), refer to the tabulation below:

Model Sector No.	Industry	g_i
1.	Agriculture, Forestry & Fisheries	.00065
2.	Coal Mining	.00147
3.	Other Mining (Metals, Crude Oil, Minerals)	.00001
4.	Construction	.13803
5.	Food and Kindred Products	.00172
6.	Textile Mill Products	.00006
7.	Apparel and Finished Products	.00124
8.	Lumber and Wood Products, Furn. & Fix.	.00050
9.	Paper & Allied Products	.00108
10.	Printing, Publishing & Allied Products	.00287

Model Sector No.	Industry	g_i
11.	Chemicals & Allied Products	.00135
12.	Petroleum Refining	.00178
13.	Rubber & Misc. Products	.00028
14.	Stone, Clay & Glass Products	.00021
15.	Ferrous Metals	.00002
16.	Nonferrous Metals	.00000
17.	Fabricated Metal Products	.00070
18.	Machinery, except Electrical	.00314
19.	Electrical Machinery	.00030
20.	Transportation Equipment	.00013
21.	Motor Vehicles	.00404
22.	Tobacco & Leather Products	.00028
23.	Ordnance, Instruments & Misc. Mfg.	.00130
24.	Transportation, Utilities & Comm.	.00859
25.	Trade (wholesale and retail)	.00049
26.	Finance, Insurance and Real Estate	.00304
27.	Services	.21118

b. Government Defense Expenditures

As previously indicated, government defense expenditures in the Ohio River Basin are projected independently or exogenously; they were not generated by the model. In summary form, our projection required two basic steps. First, we projected federal government defense expenditures for the nation as a whole, relying on the general assumptions stipulated for this study: (a) that there will be no general war, and (b) that the country will maintain its state of defense preparedness but that the level of federal defense expenditures will rise less rapidly than in recent years (i.e., defense expenditures will increase in absolute terms but will decline gradually as a percent of GNP and of total government expenditures). Second, we projected the Basin's share of national defense expenditures by using the Basin's past and projected share of prime military contracts as a guide, and distributing the projected totals among the 27 industry sectors and households on the basis of their percent distribution in 1960.

Crude as they may be in the face of national and international uncertainties, our estimates of defense expenditures in the Basin do take on significant dimensions when compared with expenditures of other kinds. In 1960, for example, total defense expenditures in the Basin amounted to approximately $2.7 billion, a sum equal to almost one-tenth of the estimated consumption expenditures of all the households in the region. It appears appropriate, therefore, to present a more detailed explanation of the defense expenditure projections for the nation and for the Basin.

(1) Projections of Defense Expenditures in the United States

On the basis of the general assumptions spelled out above and using appraisals of Defense Department programming policies made by Arthur D. Little, Inc., industry specialists, we projected U.S. national defense expenditures to decline to a level of approximately 8 percent of GNP by 1970. This decline was extrapolated to 7.5 percent by 1980, and 6 percent by the year 2010.* Translating these percent shares into absolute figures, we find that defense expenditures are projected to grow by less than 70 percent between 1960 and 1980 (see Table V). In relation to projections of total government purchases of goods and services, this rise in defense expenditures implies a reduction in the defense items' share of total government expenditures from 46 percent in 1960 to 35 percent in 1980. In that year, the share would approximate the low levels shown for the years immediately following World War II. Although the share continues to decline, it would still be above that of 1940 by the year 2010.

These figures are, to some extent, in agreement with general assumptions about some form of reduced arms production during the coming decades. Reductions in expenditures on defense hardware are likely to be offset, however, by growing expenditures on space exploration technology, particularly as the significance of the defense aspects of space exploration is increasingly realized. Furthermore, in the event that an international arms control program should come into effect, it is generally believed that the expenditures for developing and maintaining devices necessary to monitor and enforce such a program would increase sharply and, as a result, produce considerable offsets to reduced armaments expenditures.

(2) Projections of Defense Expenditures in the Ohio River Basin

As noted, our estimate of regional defense expenditures in the Basin approximated $3 billion in 1960. This represented approximately 6 percent of total national defense expenditures in that year, a share about half as large as the Basin's share of total U.S. population. In terms of population, the region is thus receiving a less-than-proportional share of the government's total defense expenditures. The Basin's share has, of course, fluctuated, reaching high points during war periods when the need for weapons and other hardware stimulated the output of the metalworking industries which are heavily concentrated in the Ohio River Basin.

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* This assumes that GNP will increase at a rate of 3.4 percent per annum between 1960 and 1980, and at 3.2 percent per annum between 1980 and 2010. (See Appendix C.)

TABLE V

NATIONAL DEFENSE EXPENDITURES AS A PERCENT OF GNP & GOVERNMENT PURCHASES OF GOODS AND SERVICES

Year	GNP (Millions of Current $)	Federal, State & Local Government Purchases of Goods & Services (Millions of Current $)	National Defense Expenditures* (Millions of Current $)	National Defense Expenditures as a Share of GNP (%)	National Defense Expenditures as a Share of Government Purchases of Goods & Services (%)
1939	91,095	13,320	1,258	1.4	9.4
1940	100,618	14,073	2,223	2.2	15.8
1941	125,822	24,751	13,794	11.0	55.7
1942	159,133	59,717	49,567	31.1	83.0
1943	192,513	88,617	80,384	41.8	90.7
1944	211,393	96,529	88,615	41.9	91.8
1945	213,558	82,867	75,923	35.6	91.6
1946	210,663	30,498	18,791	8.9	61.6
1947	234,289	28,382	11,360	4.8	40.0
1948	259,426	34,536	11,578	4.5	33.5
1949	258,054	40,159	13,570	5.3	33.8
1950	284,599	39,029	14,257	5.0	36.5
1951	328,975	60,460	33,864	10.3	56.0
1952	346,999	76,044	46,408	13.4	61.0
1953	365,385	82,830	49,289	13.5	59.5
1954	363,112	75,254	41,189	11.3	54.7
1955	397,469	75,592	39,081	9.8	51.7
1956	419,180	78,967	40,355	9.6	51.1
1957	442,769	86,536	44,406	10.0	51.3
1958	444,546	93,458	44,837	10.1	47.9
1959	482,704	97,199	46,244	9.6	47.5
1960	502,601	99,616	45,687	9.1	45.9
1961	518,173	107,909	49,003	9.5	45.4
1962	554,894	116,977	53,298	9.6	45.6
1963	585,100 (Preliminary)	125,100	56,700	9.7	45.3
		(Projections in Millions of 1960 $)			
1970	715,200	146,014	57,216	8.0	39.2
1980	998,666	216,929	74,900	7.5	34.5
1990	1,374,108	317,824	96,188	7.0	30.3
2000	1,916,414	474,594	114,985	6.0	24.2
2010	2,594,924	676,583	155,695	6.0	23.0

*For the purpose of maintaining comparability over time, national defense expenditure figures include only federal government defense expenditures and not those of state and local governments. In 1962 defense expenditures by state and local governments equaled $344 million, or less than 1% of federal defense expenditures. The latter also exclude national defense transfer payments, grants-in-aid to states and local governments, and subsidies less surplus of government enterprises, all of which amounted to approximately 3% of all national defense expenditures in 1962.

Sources: U.S. Department of Commerce, Survey of Current Business, July 1962, 1963, and Feb. 1964; and The Conference Board, the Economic Almanac, 1964, p.117.

There is some speculation that the continuing shift from hardware-type expenditures to the more research-and-development-oriented expenditures might further reduce the region's share because of its lack of facilities to perform this kind of work. It appears, however, that this shift, which has become particularly pronounced in recent years at the national level, has not had a noticeable impact on the Basin's share of prime defense contracts. In fact, between 1960 and 1963, the share of U.S. prime defense contracts awarded to firms in the Basin has risen slightly from 5.4 percent to 6.8 percent. While the factors responsible for this increase cannot be readily pinpointed, they would seem to reflect the efforts of industry and government leaders in the Basin states to reverse the region's declining share of defense expenditures and to build up research and development capabilities. Nevertheless, this is likely to be a slow process requiring many years of continued effort. We therefore project only a gradual rise in the Basin's share of national defense contracts from 5.4 percent in 1960 to approximately 7.1 percent in 1970, and 9.1 percent in 1980, at which time the share will approximate the Basin's share of total U.S. population. After 1980, the Basin's share of defense expenditures is projected to rise slowly, reaching 10.1 percent by 2010. Since prime military contract awards to the Basin have accounted for 92 percent of total defense expenditures in the Basin, we have assumed that this past relationship would hold in the future (see Table VI).

A breakdown of the projected total expenditures by industry sectors is given in Table VII. Although it is likely that the distribution among various industry sectors will change over time, we have applied the 1960 distribution for reasons of simplification. Changes in the distribution of defense expenditures among industries are likely to result from changes in military technology and are, therefore, extremely difficult to foresee. However, it is also true that some technological changes will not affect the industry distribution of defense expenditures because of our use of broad industry groupings, and because many of the existing defense industries are expected to adapt themselves to new weapons requirements.

TABLE VI

DEFENSE EXPENDITURES IN THE OHIO RIVER BASIN*

	1960	1961	1962	1963	Projected 1970	1980	1990	2000	2010
Basin's Percent Share of Prime Military Contract Awards**	5.4	5.8	6.5	6.8	7.1	9.1	9.3	9.9	10.1
Basin's Percent Share of Federal Defense Expenditures**	5.9	N.A.	N.A.	N.A.	7.8	9.9	10.2	10.8	11.0
Total Federal Defense Expenditures ($ million)	45,687	49,003	53,298	56,700	57,216	74,900	96,188	114,985	155,695
Federal Defense Expenditures in Basin ($ million)	2,709.2	N.A.	N.A.	N.A.	4,462.8	7,423.4	9,823.8	12,394.5	17,126.0

N.A.: Not available.

* : Projections of expenditure totals are in millions of 1960 dollars.

** : Rounded.

TABLE VII

DISTRIBUTION OF PROJECTED DEFENSE EXPENDITURES
IN THE OHIO RIVER BASIN
(millions of 1960 dollars)

Model Sector No.	1970	1980	1990	2000	2010
1	.2	.3	.3	.4	.6
2	9.4	15.6	20.7	26.1	36.1
3	.2	.3	.3	.4	.6
4	87.2	145.1	191.9	242.1	334.5
5	42.3	70.4	93.2	117.6	162.5
6	4.1	6.8	9.1	11.4	15.8
7	56.7	94.2	124.8	157.4	217.5
8	9.6	15.9	21.0	26.5	36.7
9	6.1	10.1	13.4	16.9	23.4
10	17.8	29.6	39.2	49.5	68.3
11	48.1	80.0	105.9	133.6	184.7
12	85.0	141.4	187.1	236.1	326.2
13	12.2	20.3	26.9	33.9	46.8
14	5.6	9.3	12.3	15.6	21.5
15	27.0	45.0	59.5	75.1	103.7
16	14.2	23.6	31.2	39.4	54.4
17	35.6	59.2	78.3	98.8	136.5
18	139.4	231.9	306.9	387.2	534.9
19	373.9	621.9	822.9	1,038.3	1,434.6
20	999.0	1,661.8	2,199.1	2,774.5	3,833.7
21	200.7	333.8	441.8	557.4	770.2
22	20.4	34.0	45.0	56.7	78.4
23	351.6	584.9	774.0	976.6	1,349.4
24	22.7	37.8	50.1	63.1	87.2
25	13.5	22.5	29.7	37.5	51.8
26	2.6	4.4	5.8	7.4	10.2
27	458.5	762.8	1,009.4	1,273.5	1,759.7
Subtotal	3,043.6	5,062.8	6,699.8	8,453.0	11,679.9
Y_{G_2} (Households)	1,419.2	2,360.6	3,124.0	3,941.5	5,446.1
Total G_2	4,462.8	7,423.4	9,823.8	12,394.5	17,126.0

Note: Y_{G_2/G_2} = 31.8 percent.

4. INVESTMENT

As explained in Appendix E-5, the investment column of the Ohio River Basin input-output framework represents expenditures for all new residential and nonresidential construction, new plant and equipment, miscellaneous charges on capital account, and net changes in inventories. Projections of investment in the Basin are made independently or exogenously, rather than being generated by the model.

We projected investment in the Basin in four steps: (1) total investment (comprising all investment categories) was projected on the basis of projected rates of growth in national gross private domestic investment; (2) regional construction was projected on the basis of projected rates of growth in national private construction expenditures; (3) future levels of construction investment were subtracted from future levels of total investment; (4) the residual (i.e., all non-construction investment expenditures) was distributed among the 26 industry sectors. The distribution of expenditures among 26 industry sectors follows the 1960 industry share breakdown and excludes sector 4 (construction) for which the projections (as shown in step 2 above) were separately determined (see Tables VIII and IX).

TABLE VIII

PROJECTIONS OF INVESTMENT IN THE OHIO RIVER BASIN
(millions of 1960 dollars)

	Actual 1960	1970	1980	1990	2000	2010
1. Gross Private Investment in the Basin	9,672.9	16,502.0	22,334.7	29,179.3	38,001.0	48,894.6
Gross Index of U.S. Gross Private Domestic Investment* (1960 = 100)	100.0	170.6	230.9	301.7	392.9	505.5
2. Private Construction Expenditures in the Basin	4,049.7	5,898.0	7,922.8	10,618.7	14,220.9	18,447.2
Growth Index of U.S. Private Construction* (1960 = 100)	100.0	145.6	195.6	262.2	351.2	455.5
3. Producers' Durable Equipment, Miscellaneous Charges on Capital Account, Net Changes in Inventories: (1) - (2)	5,623.2	10,604.0	14,411.9	18,560.6	23,780.1	30,447.4

Notes: *Refer to Appendix C. Basin projections are made by increasing the 1960 Basin total by the appropriate U.S. growth index. The indexes given here are rounded.

TABLE IX

PROJECTIONS OF INVESTMENT IN THE OHIO RIVER BASIN
BY INDUSTRY SECTORS
(millions of 1960 dollars)

Model Sector No.	Actual 1960	1970	1980	1990	2000	2010
1	63.4	119.8	162.9	209.7	268.7	344.1
2	1.6	3.2	4.3	5.6	7.1	9.1
3	10.1	19.1	25.9	33.4	42.8	54.8
4	4,049.7	5,898.0	7,922.8	10,618.7	14,220.9	18,447.2
5	53.0	99.7	135.5	174.5	223.5	286.2
6	6.4	11.7	15.9	20.4	26.2	33.5
7	- 2.9	5.3	7.2	9.3	11.9	15.2
8	65.9	124.1	168.6	217.2	278.2	356.2
9	36.5	68.9	93.7	120.6	154.6	197.9
10	- 5.6	10.6	14.4	18.6	23.8	30.5
11	48.8	91.2	123.9	159.6	204.5	261.9
12	- 2.8	5.3	7.2	9.3	11.9	15.2
13	- 4.4	8.5	11.5	14.9	19.0	24.4
14	79.9	149.5	203.2	261.7	335.3	429.3
15	335.5	628.8	854.6	1,100.6	1,410.2	1,805.5
16	57.9	108.1	147.0	189.3	242.6	310.6
17	143.8	269.3	366.1	471.4	604.0	773.4
18	1,696.5	3,181.2	4,323.6	5,568.2	7,134.0	9,134.2
19	1,131.0	2,120.8	2,882.4	3,712.1	4,756.0	6,089.5
20	251.8	471.9	641.3	825.9	1,058.2	1,354.9
21	696.1	1,305.3	1,774.1	2,284.8	2,927.3	3,748.1
22	28.6	54.1	73.5	94.7	121.3	155.3
23	66.0	124.1	168.6	217.2	278.2	356.2
24	83.0	155.9	211.9	272.8	349.6	447.6
25	468.2	878.0	1,193.3	1,536.8	1,969.0	2,521.0
26	168.7	316.0	429.5	553.1	708.7	907.3
27	146.2	273.6	371.8	478.9	613.5	785.5
Total	9,672.9	16,502.0	22,334.7	29,179.3	38,001.0	48,894.6

5. NET TRADE

The projection of the Basin's net trade with the rest of the world was developed in the following manner. First, the value of net trade in each of the region's "nonexport" industries was assumed to grow at a constant proportion of total output as determined by the model. This follows from the fact that the trade coefficient (e_i), which relates net trade in a given industry sector to its total output, is assumed to remain fixed at the 1960 level (Table X). The nonexport group of industries includes all the net importers into the region as well as those industries which are relatively minor exporters, such as motor vehicles and nonferrous metals.

The assumption that trade coefficients in the nonexport industries would be fixed throughout the projection period results from the fact that data on interregional trade flows and their trends are extremely scarce. Under these circumstances, it would have been possible at best to analyze each Basin industry with regard to its comparative advantage or disadvantage vis-à-vis the same industry in other parts of the country. Such an analysis could not be undertaken within the scope of this "framework" economic study. It should be stated, moreover, that the effect of assuming fixed trade coefficients is negligible insofar as projected industry outputs are concerned, where net trade represents but a small fraction of gross output.

We then assumed that the value of net trade in each of the "export" industries would grow at the same rate as the industry's total regional output as independently projected (Table XI). The only exception to this procedure was Sector 15--Ferrous Metals (chiefly steel), in which the Basin's net trade is projected to decline by 5 percent between 1960 and 1970, and by 10, 15, 20, and 25 percent, respectively, during each succeeding decade. (For details of that projection, see Appendix K.)

TABLE X

OHIO RIVER BASIN NET TRADE COEFFICIENTS* (e_i)
(fixed for the projection period)

Model Sector No.	Industry	e_i
1	Agriculture, Forestry, and Fisheries	.025984
2	Coal Mining	.000000
3	Other Mining (Metals, Crude Oil, Minerals)	- .320989
4	Construction	- .073947
5	Food and Kindred Products	- .050368
6	Textile Mill Products	-2.086957
7	Apparel and Finished Products	-1.359592
8	Lumber and Wood Products, Furn. & Fix.	- .187126
9	Paper & Allied Products	- .269789
10	Printing, Publishing & Allied	- .063737
11	Chemicals & Allied Products	.000000
12	Petroleum Refining	- .605758
13	Rubber & Misc. Products	- .017498
14	Stone, Clay & Glass Products	.000000
15	Ferrous Metals	.000000
16	Nonferrous Metals	- .049969
17	Fabricated Metal Products	.000000
18	Machinery, except Electrical	.000000
19	Electrical Machinery	.000000
20	Transportation Equipment	- .147581
21	Motor Vehicles	.032745
22	Tobacco & Leather Products	- .038875
23	Ordnance, Instruments & Misc. Mfg.	- .925110
24	Transportation, Utilities & Comm.	- .058170
25	Trade (wholesale and retail)	- .031962
26	Finance, Insurance and Real Estate	- .291225
27	Services	- .090582

* Net Trade/Gross Output.

Note: The "export" industries, whose coefficients are not fixed for the projection period, are shown with a coefficient of zero.

TABLE XI

EXPORT PROJECTIONS BY MAJOR "EXPORT" SECTORS, OHIO RIVER BASIN

(millions of 1960 dollars)

Model Sector No.	Industry	1960 (Actual)	1970	1980	1990	2000	2010
2	Coal Mining	1163.0	1581.7	2442.3	3326.2	4291.5	5326.5
	Growth Index	100	136	210	286	369	458
11	Chemicals and Allied Products	222.7	365.2	552.3	799.5	1153.6	1596.8
	Growth Index	100	164	248	359	518	717
14	Stone, Clay and Glass Products	904.1	1202.5	1564.1	2043.3	2739.4	3616.4
	Growth Index	100	133	173	226	303	400
15	Ferrous Metals	3162.7	3004.6	2704.1	2298.5	1838.8	1379.1
	Growth Index	100	95	85	73	58	44
17	Fabricated Metal Products	703.9	957.3	1288.1	1752.7	2463.6	3343.5
	Growth Index	100	136	183	249	350	475
18	Machinery, except Electrical	284.7	495.4	680.4	939.5	1335.2	1824.9
	Growth Index	100	174	239	330	469	641
19	Electrical Machinery	1273.9	2114.7	3159.3	4573.3	6624.3	9184.8
	Growth Index	100	166	248	359	520	721

6. PRODUCTIVITY

Future levels of productivity in individual industries of the Ohio River Basin were projected independently to enable us to derive industry employment forecasts from the model-generated output projections.*

The procedure used in estimating future levels of productivity for the Basin industry sectors involved the following two-stage process. First, using 1960 as a base year, indexes of gross product per employee were projected for each industry sector by means of least-squares correlations based on postwar national series (see Table XII, page F-27). Second, these projected productivity (i.e., gross output per employee) indexes were multiplied by the base year (1960) productivity levels prevailing in the Ohio River Basin, computed by dividing the region's gross output in each industry sector by the number of employees in that sector (see Table XIII, page F-28). These two steps are now explained in detail, with emphasis on the first one which, in fact, reveals the basic assumptions which were made in arriving at the productivity projections used in this study.

a. Projections of Productivity Indexes

This section discusses the assumptions underlying the method we used, explains the method itself, and provides general comments on data sources and empirical problems encountered in implementing the method.

(1) Basic Assumptions and Methodology

Assumptions

i. Future increases in gross output per employee will follow the same rates of change as in the historical past.**

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* These projected productivity levels are also used in the last step of our framework implementation, following the reconciliation of the demographic and model projections of the labor force and the subsequent adjustments in the model-projected employment levels in accordance with the "equilibrium" labor force results. At that point, "equilibrium" output projections for each industry sector are derived by applying the productivity levels developed in this Appendix to the projected "equilibrium" employment levels in the Basin.

**This assumption was made for all but the agriculture and coal mining sectors.

ii. The rates of increase in gross output per employee in Basin industries will parallel the increases projected by use of national data. This assumption is necessary because there is insufficient historical data available concerning productivity increases at the regional level.

iii. The change in gross output per employee over time can be described by an equation of the type:

$$y_i = c_i (1 + r_i)^t \quad \ldots\ldots\ldots\

(2) Data Sources and Empirical Problems

National data on gross product by major industry sectors were published in the Survey of Current Business (October 1962, pp.6-18), covering the period 1947-1960. A subsequent issue of the Survey of Current Business (September 1963) provided revised and updated gross product estimates for the period 1958-1962, for the same major industry sectors.* Computed by Martin L. Marimont of the U.S.Department of Commerce, these industry gross product series are presented in both current and constant (1954) dollars. We used Marimont's constant dollar series in developing our historical series of gross product per employee for agriculture-forestry-fisheries, mining, construction, wholesale and retail trade, transportation-communications-utilities, finance-insurance-real estate, services, and government.

In deriving gross product per employee series, we used a corresponding series of "number of persons engaged in production" by industry, likewise published in the Survey of Current Business.**

The use of Marimont's gross product data, however, was beset by two important limitations. In the first place, Marimont's data did not fully meet the needs of this study because his industry breakdown was insufficient for what was required by our model framework. For example, his gross product series for mining had to be split for our purposes into "coal mining" and "other mining," and we could not use Marimont's gross product data for the manufacturing sector, because they covered only the two broad categories of "durable" and "nondurable goods" industries instead of providing data for the individual manufacturing

* Survey of Current Business gives the following industry breakdown: all industries; agriculture, forestry, fisheries; mining; contract construction; total manufacturing; wholesale and retail trade; finance, insurance, real estate; transportation, communications, public utilities; services; government and government enterprises; and rest of the world. For some of these industry categories, separate series are also presented for major components comprising the major sector (e.g., "durable goods manufacturing" and "nondurable goods manufacturing" under "total manufacturing," "railroads" under transportation, etc.).

** "Number of persons engaged in production" includes the number of full-time equivalent employees by industry, plus proprietors of unincorporated businesses devoting the major portion of their time to the business. In the sense that the "number of persons engaged in production" does not include unpaid family workers, it falls short of total man-years of full-time employment. Nonetheless, because they are most complete in coverage and because they are in definitional agreement with the gross product series, we decided to use these employment estimates in conjunction with Marimont's gross product series.

industries included in the Ohio River Basin projection framework. For these reasons, we either used Marimont's data by aggregating or disaggregating them wherever necessary, or else we developed more indirect measurements of gross product per employee, as in the case of the individual manufacturing industries.

The use of Marimont's data was limited in a second important respect. Our preliminary productivity projections for the government sector and for each of the nonmanufacturing industry sectors, based on historical data compiled from Marimont's work, resulted in productivity increases in these sectors that were either too high or too low. This experiment raised questions about the validity of using data for the postwar period (1947-1962) to develop long-term productivity projections. In agriculture, coal mining, and the transportation-communication-utilities sectors, for example, the increase in productivity during the period 1947-1962 was found to be too high to be sustainable in the long run. In coal mining, for instance, the average annual growth rate in productivity (gross product per employee) during the period 1947-1961 was 6.1 percent, as compared with an average annual growth rate of 2.65 percent over the period 1910-1960. It thus became evident that the unqualified use of postwar data on productivity trends would have led to unreasonable conclusions about the future growth of employment in several sectors of the economy. We therefore used Marimont's data with great caution in projecting productivity increases in the nonmanufacturing sectors.

b. Derivation of Base Year Productivity Levels

Defined as gross product per employee, productivity levels for the Ohio River Basin for 1960 were obtained by dividing the base year gross output levels given in the base year input-output table by the corresponding employment levels in each industry. The derivation of base year employment data for the Basin will now be explained.

Employment levels for 1960 in both the manufacturing and nonmanufacturing industry sectors (except the mining sectors), were taken from the 1960 Census of Population. In those cases where the Census employment aggregation did not conform to the more detailed industry breakdown of the Ohio River Basin model framework, we disaggregated Census totals by indirect means. For example, the Census total for "other nondurable goods" group had to be allocated among SIC 21, 26, 29, 30, and 31. To make this allocation, we first obtained the 1958 employment levels for each of these industries in the Basin from the special Census of Manufactures tabulation provided by the Bureau of the Census. Each 1958 total was then updated to 1960, on the basis of growth rates computed for 1958-1960 from the area statistics of the Annual Survey of Manufactures for these years. When summed, the updated employment total of the industries in the "other nondurable goods" group fell below the 1960 Census of Population total.

Consequently, we disaggregated the Census of Population employment total for the group into the above-listed two-digit SIC categories on the basis of the percent distribution of the updated employment levels (i.e., updated employment in each industry as a percent of total updated employment in the group).

For the "coal mining" and "other mining" sectors, a somewhat different method of derivation was used. We first approximated the Basin's 1960 employment totals in these two sectors by multiplying the Basin's percent share of total U.S. employment in each sector, as computed from the 1958 Census of Minerals, by the respective U.S. employment levels in 1960, as given in the 1960 Census of Population. The results, when summed, fell slightly below the Basin's total mining employment obtained directly by summing mining employment in the Basin counties, as given in the 1960 Census of Population. It was then decided to use the mining employment total obtained by summing the individual country data, and to apportion this total to the two model sectors, "coal mining" and "other mining" on the basis of the 1958 Basin employment in these sectors as computed from the 1958 Census of Minerals.

TABLE XII

INDEX OF PRODUCTIVITY INCREASES BY INDUSTRY SECTORS, 1960-2010
(1960=1.000)

Ohio River Basin Model Sector No.	SIC	Industry Title	1970	1980	1990	2000	2010	Average Annual Compound Rate of Growth (percent)
1	A (01-09)	Agriculture, Forestry, & Fisheries	1.542	2.181	2.811	3.359	3.848	2.75
2	B (11, 12)	Coal Mining	1.757	2.917	4.602	6.812	9.516	4.63
3	B (10, 13, 14)	Other Mining (metals, crude oil, minerals)	1.224	1.491	1.871	2.214	2.698	2.00
4	C (15, 16, 17)	Construction	1.278	1.576	1.600	1.725	1.965	1.34
5	D (20)	Food & Kindred Products	1.380	1.932	2.705	3.788	5.304	3.40
6	D (22)	Textile Mill Products	1.272	1.669	2.190	2.874	3.772	2.69
7	D (23)	Apparel & Finished Products	1.125	1.254	1.399	1.561	1.741	1.13
8	D (24, 25)	Lumber & Wood Products, Furniture & Fixtures	1.106	1.246	1.403	1.581	1.781	1.16
9	D (26)	Paper & Allied Products	1.348	1.779	2.347	3.096	4.086	2.81
10	D (27)	Printing, Publishing, & Allied Prod.	1.266	1.604	2.033	2.576	3.263	2.38
11	D (28)	Chemicals & Allied Products	1.439	2.065	2.962	4.251	6.100	3.70
12	D (29)	Petroleum Refining	1.308	1.778	2.424	3.306	4.509	3.10
13	D (30)	Rubber & Misc. Plastics	1.187	1.459	1.792	2.201	2.703	2.00
14	D (32)	Stone, Clay & Glass Products	1.334	1.729	2.243	2.909	3.772	2.69
15	D (331, 332, 339)	Ferrous Metals	1.519	2.121	2.964	4.140	5.784	3.63
16	D (333, 334, 335, 336)	Nonferrous Metals	1.278	1.585	1.966	2.437	3.022	2.25
17	D (34)	Fabricated Metal Products	1.157	1.314	1.492	1.694	1.924	1.31
18	D (35)	Machinery, except Electrical	1.207	1.436	1.708	2.032	2.418	1.81
19	D (36)	Electrical Machinery	1.244	1.498	1.803	2.171	2.614	1.94
20	D (37, excl. 371)	Transportation Equipment	1.506	2.145	3.054	4.349	6.193	3.70
21	D (371)	Motor Vehicles	1.428	2.084	3.042	4.440	6.480	3.80
22	D (21, 31)	Tobacco & Leather Products	1.398	1.956	2.735	3.825	5.350	3.40
23	D (19, 38, 39)	Ordnance, Instruments & Misc. Mfg.	1.252	1.620	2.096	2.711	3.507	2.56
24	E (40-49)	Transp., Commun., & Utilities	1.251	1.538	1.979	2.490	3.159	2.31
25	F (50-59)	Trade (wholesale & retail)	1.251	1.538	1.979	2.490	3.159	2.31
26	C (60-67)	Finance, Insurance & Real Estate	1.251	1.538	1.979	2.490	3.159	2.31
27	H (70-89)	Services	1.136	1.297	1.481	1.691	1.931	1.31
28	I (91-93)	Government (Nondefense)	1.136	1.297	1.481	1.691	1.931	1.31

TABLE XIII

PRODUCTIVITY LEVELS BY INDUSTRY SECTORS, 1960-2010*
(in 1960 dollars)

Ohio River Basin Model Sector No.	SIC	Industry Title	1960 (actual)	1970	1980	1990	2000	2010
1	A (01-09)	Agriculture, Forestry, & Fisheries	10,721.12	16,531.97	23,382.76	30,137.07	36,012.24	41,254.87
2	B (11, 12)	Coal Mining	10,170.64	17,869.81	29,663.88	46,809.60	69,278.21	96,781.66
3	B (10, 13, 14)	Other Mining (metals, crude oil, minerals)	30,543.46	37,385.20	45,540.30	55,497.47	67,623.22	84,406.26
4	C (15, 16, 17)	Construction	20,363.61	26,027.21	32,086.57	32,589.98	35,119.78	40,022.46
5	D (20)	Food & Kindred Products	38,480.85	53,103.57	74,345.00	104,090.70	145,765.46	204,102.43
6	D (22)	Textile Mill Products	11,858.09	15,083.49	19,791.15	25,969.22	34,080.15	44,728.72
7	D (23)	Apparel & Finished Products	9,925.94	11,116.68	12,447.13	13,886.39	15,494.39	17,281.06
8	D (24, 25)	Lumber and Wood Products, Furniture and Fixtures	12,604.21	13,940.26	15,704.85	17,683.71	19,927.26	22,448.10
9	D (26)	Paper and Allied Products	24,947.97	33,629.86	44,382.44	58,552.89	77,238.92	101,937.41
10	D (27)	Printing, Publishing, & Allied Prod.	11,770.26	14,901.15	18,879.50	23,928.94	30,320.19	38,406.36
11	D (28)	Chemicals and Allied Products	36,472.55	52,484.00	75,315.82	108,031.69	155,044.81	222,402.56
12	D (29)	Petroleum Refining	56,417.77	73,794.44	100,310.80	136,756.67	186,517.15	254,387.72
13	D (30)	Rubber and Miscel. Plastics	19,061.54	22,626.05	27,810.79	34,158.29	41,954.45	51,523.34
14	D (32)	Stone, Clay and Glass Prods.	15,742.91	21,001.04	27,219.49	35,311.34	45,796.13	59,382.26
15	D (331, 332, 339)	Ferrous Metals	27,054.02	41,095.06	57,381.58	80,188.12	112,003.64	156,750.99
16	D (333, 334, 335, 336)	Nonferrous Metals	27,163.36	34,714.77	43,053.93	53,403.17	66,197.11	82,087.67
17	D (34)	Fabricated Metal Products	22,776.35	26,352.24	29,928.12	33,982.31	38,583.14	43,821.70
18	D (35)	Machinery Except Electrical	20,376.70	24,594.56	29,260.80	34,803.23	41,405.25	49,270.62
19	D (36)	Electrical Machinery	19,215.01	23,903.47	28,784.08	34,644.63	41,715.79	50,228.04
20	D (37, excl. 371)	Transp. Equipment	23,843.28	35,907.98	51,143.83	72,817.38	103,694.42	147,661.43
21	D (371)	Motor Vehicles	37,561.44	53,637.74	78,278.04	114,261.90	166,772.49	243,398.13
22	D (21, 31)	Tobacco and Leather Prods.	31,171.84	43,578.23	60,972.12	85,254.98	119,232.29	166,769.34
23	D (19, 38, 39)	Ordnance, Instruments & Miscel. Mfg.	18,283.66	22,891.14	29,619.53	38,322.55	49,567.00	64,120.80
24	E (40-49)	Transp., Commun., & Util.	14,754.35	18,457.69	22,692.19	29,198.86	36,738.33	46,608.99
25	F (50-59)	Trade (wholesale & retail)	8,941.80	11,186.19	13,752.49	17,695.82	22,265.08	28,247.15
26	G (60-67)	Fin., Insur., & Real Estate	42,698.68	53,416.05	65,670.57	84,500.69	106,319.71	134,885.13
27	H (70-89)	Services	7,195.60	8,174.20	9,332.69	10,656.68	12,167.76	13,894.70
28	I (91-93)	Government (Nondefense)	20,932.50	23,779.32	27,149.45	31,001.03	35,396.86	40,420.66

*Obtained by multiplying each industry's projected productivity index by its gross output per employee in 1960. Totals are not rounded to the nearest dollar to avoid rounding errors in the subsequent derivation of employment levels in the Ohio River Basin (i.e., employment in a given industry sector is found by dividing its projected gross output by the productivity level presented here).

APPENDIX G

OHIO RIVER BASIN MODEL PROJECTIONS

This Appendix presents the detailed projections of output, employment and labor force in the Ohio River Basin as derived from the econometric model. These projections were reconciled with the demographic projections of the labor force to produce the so-called equilibrium projections given in Appendix H.

It is important to note that the allocations of projected employment and output to the 19 subareas were made from the equilibrium projections for the Basin, not from the model-derived projections contained in this Appendix. It should be further noted that some adjustments were made in the productivity projections after completion of the model employment projections but prior to the computation of the equilibrium projections given in Appendix H. This accounts for minor differences in the distribution of total employment among the several industry sectors shown in Table II of this Appendix and in the corresponding table of Appendix H.

TABLE I

OHIO RIVER BASIN GROSS OUTPUT PROJECTIONS*
(millions of 1960 dollars)

Ohio River Basin Sector No.	Industry Title	(Actual) 1960	1970	1980	1990	2000	2010
1	Agriculture, Forestry, & Fisheries	4,510.4	4,706.8	4,909.8	5,344.1	5,695.4	6,303.8
2	Coal Mining	1,391.1	2,034.6	2,956.7	4,009.6	5,125.7	6,496.7
3	Other Mining (metals, crude oil, minerals)	1,066.7	1,504.7	2,115.4	2,782.7	3,691.9	4,828.5
4	Construction	7,174.1	10,747.7	16,042.9	22,325.3	31,379.1	41,440.0
5	Food & Kindred Products	6,390.9	8,799.6	12,261.1	16,215.5	21,460.4	28,094.6
6	Textile Mill Products	232.3	319.9	439.9	564.2	747.3	964.6
7	Apparel & Finished Products	696.9	983.0	1,385.3	1,851.2	2,469.3	3,256.8
8	Lumber and Wood Products, Furniture and Fixtures	1,185.3	1,651.9	2,313.1	3,063.6	4,076.4	5,324.5
9	Paper and Allied Products	1,246.9	1,828.0	2,701.2	3,610.6	4,839.7	6,370.3
10	Printing, Publishing, & Allied Products	1,308.5	1,918.3	2,822.6	3,779.9	5,073.3	6,708.0
11	Chemicals and Allied Products	3,920.8	6,030.2	9,275.6	12,839.6	17,578.6	23,554.0
12	Petroleum Refining	1,000.4	1,480.6	2,217.8	3,065.4	4,200.0	5,652.3
13	Rubber and Miscellaneous Plastics	834.4	1,223.2	1,803.9	2,443.7	3,318.4	4,409.8
14	Stone, Clay and Glass Products	2,270.9	3,089.2	4,216.2	5,467.4	7,296.9	9,557.2
15	Ferrous Metals	8,348.9	8,959.5	9,616.5	10,218.4	11,199.8	12,449.3
16	Nonferrous Metals	1,284.8	1,794.9	2,519.4	3,268.6	4,273.7	5,542.7
17	Fabricated Metal Products	3,370.9	4,812.7	6,733.1	9,040.1	12,214.6	16,158.9
18	Machinery, except Electrical	4,029.9	6,141.6	9,336.0	12,407.7	16,367.4	21,122.9
19	Electrical Machinery	4,504.0	7,163.7	11,360.6	15,697.6	21,794.2	28,904.3
20	Transportation Equipment	1,469.7	2,370.6	3,862.1	5,159.4	6,780.7	9,168.5
21	Motor Vehicles	3,347.1	5,298.5	8,338.4	11,471.8	15,528.7	20,853.4
22	Tobacco and Leather Products	1,209.0	1,673.3	2,311.2	3,031.6	3,903.4	5,136.8
23	Ordnance, Instruments & Miscellaneous Mfg.	749.1	1,149.5	1,769.2	2,405.5	3,235.2	4,308.5
24	Transportation, Communications & Utilities	6,432.9	8,903.1	12,318.7	16,397.6	22,079.3	29,233.8
25	Trade (wholesale and retail)	10,090.0	14,935.6	22,091.6	29,364.3	39,628.9	52,616.7
26	Finance, Insurance & Real Estate	8,757.5	13,763.7	21,784.0	30,419.0	41,402.5	55,704.8
27	Services	8,869.3	12,878.2	18,664.4	25,722.3	35,437.4	47,816.4

*Obtained by correcting model projections of gross output levels for the base year discrepancy between "computed" and "actual" gross output values, where the "computed" values were greater than "actual" values by an average of about 3 percent.

TABLE II

OHIO RIVER BASIN PROJECTIONS OF EMPLOYMENT AND LABOR FORCE
(thousands of persons)

Ohio River Basin Sector No.	Industry Title	(Actual) 1960	1970	1980	1990	2000	2010
1	Agriculture, Forestry, & Fisheries	420.7	284.7	210.0	177.3	158.2	152.8
2	Coal Mining	136.8	113.9	99.7	85.7	74.0	67.1
3	Other Mining (metals, crude oil, minerals)	34.9	40.2	46.5	50.1	54.6	57.2
4	Construction	352.3	497.9	707.8	937.8	1,255.9	1,580.1
5	Food & Kindred Products	166.1	165.7	164.9	155.8	147.2	137.7
6	Textile Mill Products	19.6	21.2	22.2	21.7	21.9	21.6
7	Apparel & Finished Products	70.2	88.4	111.3	133.3	159.4	188.5
8	Lumber and Wood Products, Furniture and Fixtures	94.0	118.5	147.3	173.2	204.6	237.2
9	Paper and Allied Products	50.0	54.4	60.9	61.7	62.7	62.5
10	Printing, Publishing, & Allied Products	111.2	128.7	149.5	158.0	167.3	174.7
11	Chemicals and Allied Products	107.5	114.9	123.2	118.9	113.4	105.9
12	Petroleum Refining	17.7	21.4	22.1	22.4	22.5	22.2
13	Rubber and Miscellaneous Plastics	43.8	54.1	64.9	71.5	79.1	85.6
14	Stone, Clay and Glass Products	144.2	147.1	154.9	154.8	159.3	160.9
15	Ferrous Metals	308.6	218.0	167.6	127.4	100.0	79.4
16	Nonferrous Metals	47.3	51.7	58.5	61.2	64.6	67.5
17	Fabricated Metal Products	148.0	182.6	225.0	266.0	316.6	368.7
18	Machinery, except Electrical	197.8	249.7	319.1	256.5	395.3	428.7
19	Electrical Machinery	234.4	299.7	394.7	453.1	522.4	575.5
20	Transportation Equipment	61.6	66.0	75.5	70.9	65.4	62.1
21	Motor Vehicles	89.1	98.8	106.5	100.4	93.1	85.7
22	Tobacco and Leather Products	38.8	38.4	37.9	35.6	32.7	30.8
23	Ordnance, Instruments & Miscellaneous Mfg.	41.0	50.2	59.7	62.8	65.3	67.2
24	Transportation, Communications & Utilities	436.0	490.6	556.6	607.0	669.6	726.6
25	Trade (wholesale and retail)	1,128.4	1,358.0	1,647.1	1,793.5	1,982.9	2,157.8
26	Finance, Insurance & Real Estate	205.1	262.1	340.1	389.1	433.8	478.4
27	Services	1,232.6	1,455.1	1,729.2	1,952.3	2,109.1	2,436.8
28	Government	256.3	309.9	395.8	512.4	666.9	824.4
29	Nonclassified	227.5	157.1	184.4	204.9	229.4	257.4
	TOTAL EMPLOYMENT	6,421.5	7,139.0	8,382.9	9,315.3	10,427.2	11,701.0
	Unemployment	411.4	359.9	422.7	469.7	525.7	590.0
	CIVILIAN LABOR FORCE	6,832.9	7,498.9	8,805.6	9,785.0	10,952.9	12,291.0
	Armed Forces	85.3	81.0	76.0	73.0	71.0	69.0
	TOTAL LABOR FORCE	6,918.2	7,579.9	8,881.6	9,858.0	11,023.9	12,360.0

NOTES: Employment projections are derived by dividing the gross output projections for each projection year, corrected for the statistical discrepancy between the computed and the actual base year gross output values, by projected productivity levels as explained in Appendix F-6. For assumptions about unemployment, etc., refer to the text, Chapter IV, Section B, Part 4.

APPENDIX H

RECONCILIATION ("EQUILIBRIUM") PROJECTIONS OF LABOR FORCE, EMPLOYMENT, OUTPUT, PERSONAL INCOME, AND POPULATION IN THE OHIO RIVER BASIN

This Appendix presents the reconciliation or "equilibrium" projections of total labor force, employment, output, personal income and population for the Ohio River Basin, which are offered as our final regional projections (see Tables I, II, and III).

It will be recalled from Chapter IV that our regional projection framework produced two sets of labor force projections, namely the demographic projection (presented in Appendix D) and the econometric projections (presented in Appendix G). As previously explained, we view the interaction between the forces of the supply of labor, as represented by our demographic projection of the labor force and the population, and the demand for labor, as represented by our econometric projections, as the determinant of the future level and structure of employment and output in the Ohio River Basin. These two interdependent forces, when reconciled, produce the "equilibrium" levels of employment, output, personal income and population in the region.

A full discussion of the method by which the "equilibrium" projection results were obtained is found in Chapter IV. This Appendix details the sequential process whereby the "equilibrium" labor force, employment, and output projections were determined, and explains the derivation of the "equilibrium" personal income projections for the Basin.

1. "EQUILIBRIUM" PROJECTIONS OF LABOR FORCE, EMPLOYMENT, AND OUTPUT

As a first step, we averaged the demographic (supply) and the econometric (demand) projections of the total labor force for each projection year, thus obtaining the "equilibrium" total labor force for the region. Since the discrepancy between the two sets of labor force projections did not, at first comparison, exceed a 10 percent margin of difference, we did not feel the need to re-examine the assumptions and methodology underlying either the demographic or the econometric projections of the total labor force.

Next, we proceeded to reconcile our econometric projections of employment and output with the "equilibrium" total labor force projections. We began by deducting the projected number of persons in the armed forces from the "equilibrium" total labor force projection for a given year, in order to obtain the "equilibrium" civilian labor force. Then, assuming an unemployment rate of 4.8 percent, we obtained the total employment projection. Assuming further that employment in the "nonclassified" sector will average 2.25 percent of projected total employment, and accepting our previous projections of government nondefense employment, we determined the "equilibrium" employment total in the 27 industry sectors. To obtain the "equilibrium" employment levels for each of the 27 industry sectors, we then adjusted the econometric model-derived employment projections for each industry sector slightly downward in the years 1970, 1980, and 1990, and slightly upward in 2000 and 2010, by using scalar coefficients. These scalar coefficients were derived for each year by dividing the "equilibrium" employment total for the 27 industry sectors by the model-derived projection of employment total for the 27 industry sectors.

As a final step, we multiplied the "equilibrium" employment levels of the 27 industry sectors for each projection year by our projections of productivity levels in each industry sector (shown in Appendix F) to determine the "equilibrium" gross output projections.

2. "EQUILIBRIUM" PERSONAL INCOME PROJECTIONS FOR THE OHIO RIVER BASIN

The "equilibrium" personal income projections for the Ohio River Basin were obtained by means of a two-step process. First, a set of computer-generated regional personal income projections were made, by using a set of parameters and variables defining the system of relationships underlying personal income as inputs in a computer program. Then, the numerical relationship between the model-generated personal income total and the model-projected total regional gross output (sum of 27 gross output levels) was determined for each year and expressed as a ratio or scalar coefficient. Second, the scalar coefficient for each year was applied to the "equilibrium" regional gross output (sum of 27 gross output levels) for that year to obtain the "equilibrium" personal income total. This two-step process is summarized below in the form of a proportionality equation, where the numerator on the right-hand side represents the unknown "equilibrium" personal income total for the region in a given year.

$$\frac{\text{Total Personal Income } (Y^{y}_{p.ORB})}{\text{Total Gross Output } (\sum_{i}^{27} X^{y}_{i})} = \frac{\text{Total "Equilibrium" Personal Income } (\overline{Y}^{y}_{p.ORB})}{\text{Total "Equilibrium" Gross Output } (\sum_{i}^{27} \overline{X}^{y}_{i})}$$

where:

X_i = Computer-generated gross output level for industry sector i (i = 1, 2, ... , 27), corrected for the base year error margin.

$\overline{X}_i$ = "Equilibrium" gross output level for industry sector i (i = 1, 2, ... , 27)

y = Benchmark year (1970, ... , 2010)

$Y_{p.ORB}$ = Total personal income, corrected for base year error margin.

A more detailed explanation follows, encompassing the mathematical derivation of computer-generated personal income, computer solution, and the final determination of "equilibrium" personal income totals for the Ohio River Basin in each benchmark projection year.

a. Derivation (General Note: for explanation of the symbols used, refer to Chapter III)

(i) $Y_{p.ORB} = \sum_j h_j Y_j + Y_{G_1} + Y_{G_2}$ (From Equation 31, Chapter III)

(ii) $Y_{G_I} = p (Y_{p.ORB}{}^{\gamma})$ (From Equations 32, 33, Chapter III)

Substituting (ii) into (i) and rewriting the resulting equation gives:

(iii) $Y_{p.ORB} - p (Y_{p.ORB}{}^{\gamma}) = \sum_j h_j Y_j + Y_{G_2}$, or ,

(iii-a) $Y_{p.ORB} (1 - p\gamma) = \sum_j h_j Y_j + Y_{G_2}$, or ,

(iii-b) $Y_{p.ORB} = \dfrac{\sum_j h_j Y_j + Y_{G_2}}{1 - p\gamma}$

Since $Y_j = (1 - a_{N_j}) X_j$ (From Equation 20, Chapter III)

equation (iii-b) becomes:

$$\text{(iii-c)} \quad Y_{p.ORB} = \frac{\sum_j h_j (1 - a_{N_j}) X_j + Y_{G_2}}{1 - p\,\gamma}$$

b. Computer Solution

First, parameters h_j, $(1 - a_{N_j})$, p and variables γ and Y_{G_2}, together with X_j projections (gross input or output levels, obtained through the computer solution of the 27 x 27 system of simultaneous equations, (as explained in Chapter IV) were used as inputs in a FORTRAN coded program using an IBM 1401, to project total personal income in the Ohio River Basin.

Then, the personal income projection for the Basin for each benchmark year was corrected for the base year (1960) error margin of 3.14 percent.

c. Reconciliation ("Equilibrium") Projections of Personal Income

The model-generated and corrected personal income projections for the Basin were then used to derive "equilibrium" personal income projections for the region, as explained below.

First, the model-projected personal income and regional gross output totals for each decade were corrected for the base year statistical discrepancy. Then, personal income and gross output were expressed in index terms, 1960 = 100, and the numerical relationship between these two indexes (scalar coefficient) was derived as shown below.

	1970	1980	1990	2000	2010
$\frac{\text{Basin's Total Personal Income Index}}{\text{Basin's Total Gross Output Index}} = r$	1.030290	1.048487	1.076600	1.101994	1.124363

Second, the Basin's projected "equilibrium" total gross output for each year was multiplied by the corresponding scalar coefficient in order to obtain for that year the Basin's total "equilibrium" personal income.

TABLE I

OHIO RIVER BASIN PROJECTIONS OF EMPLOYMENT AND LABOR FORCE*
(thousands of persons)

Ohio River Basin Model Sector No.	SIC	Industry Title	1960 (Actual)	1970	1980	1990	2000	2010
1.	A (01-09)	Agriculture, Forestry & Fisheries	420.7	283.8	203.3	173.0	158.9	157.7
2.	B (11, 12)	Coal Mining	136.8	113.5	96.5	83.6	74.3	69.2
3.	B (10, 13, 14)	Other Mining (Metals, Crude Oil, Minerals)	34.9	40.1	45.0	48.9	54.8	59.0
4.	C (15, 16, 17)	Construction	352.3	411.6	484.0	668.5	897.5	1,068.4
5.	D (20)	Food and Kindred Products	166.1	165.2	159.6	152.1	147.9	142.1
6.	D (22)	Textile Mill Products	19.6	21.1	21.5	21.2	22.0	22.3
7.	D (23)	Apparel and Finished Products	70.2	88.1	107.8	130.1	160.1	194.5
8.	D (24, 25)	Lumber and Wood Products, Furn. & Fix.	94.0	118.1	142.6	169.0	205.5	244.7
9.	D (26)	Paper & Allied Products	50.0	54.2	59.0	60.2	63.0	64.5
10.	D (27)	Printing, Publishing & Allied Products	111.2	128.3	144.7	154.2	168.0	180.2
11.	D (28)	Chemicals & Allied Products	107.5	114.5	119.3	116.0	113.9	109.3
12.	D (29)	Petroleum Refining	17.7	21.3	21.4	21.9	22.6	22.9
13.	D (30)	Rubber & Misc. Products	43.8	53.9	52.8	69.8	79.5	88.3
14.	D (32)	Stone, Clay & Glass Products	144.2	146.6	150.0	151.1	160.0	166.0
15.	D (331, 332, 339)	Ferrous Metals	308.6	217.3	162.2	124.3	100.4	81.9
16.	D (333, 334, 335, 336)	Nonferrous Metals	47.3	51.6	56.6	59.7	64.9	69.6
17.	D (34)	Fabricated Metal Products	148.0	182.0	217.8	259.6	318.0	380.4
18.	D (35)	Machinery, Except Electrical	197.8	248.9	308.9	347.9	397.1	442.3
19.	D (36)	Electrical Machinery	234.4	298.7	382.1	442.2	524.7	593.8
20.	D (37, excl. 371)	Transportation Equipment	61.6	65.8	73.1	69.2	65.7	64.1
21.	D (371)	Motor Vehicles	89.1	98.5	103.1	98.0	93.5	88.4
22.	D (21, 31)	Tobacco & Leather Products	38.8	38.3	36.7	34.7	32.8	31.8
23.	D (19, 38, 39)	Ordnance, Instruments & Misc. Mfg.	41.0	50.1	57.8	61.3	65.6	69.3
24.	E (40-49)	Transportation, Utilities & Comm.	436.0	480.8	525.5	548.1	603.7	647.2
25.	F (50-59)	Trade (wholesale and retail)	1,128.4	1,331.0	1,555.1	1,619.4	1,787.7	1,921.8
26.	G (60-67)	Finance, Insurance and Real Estate	205.1	256.9	321.1	351.3	391.1	426.1
27.	H (70-89)	Services	1,232.6	1,570.5	1,936.0	2,355.6	2,800.0	3,550.6
28.		Government	256.3	309.9	395.8	512.4	666.9	824.4
29.		Nonclassified	227.5	156.6	178.8	200.3	230.4	265.0
		TOTAL EMPLOYMENT	6,421.5	7,117.2	8,128.1	9,103.6	10,470.5	12,045.8
		UNEMPLOYED	411.4	358.8	409.8	459.0	527.9	607.4
		CIVILIAN LABOR FORCE	6,832.9	7,476.0	8,537.9	9,562.6	10,998.4	12,653.2
		ARMED FORCES	85.3	81.0	76.0	73.0	71.0	69.0
		TOTAL LABOR FORCE	6,918.2	7,557.0	8,613.9	9,635.6	11,069.4	12,722.2

*These employment and labor force projections, referred to as the "equilibrium" projections, represent the final regional control totals that were allocated among the 19 subareas of the Ohio River Basin. For detailed explanation, refer to Chapter IV. For detailed subarea tables, refer to Table II-5, Chapter II.

TABLE II

OHIO RIVER BASIN GROSS OUTPUT PROJECTIONS*
(millions of 1960 dollars)

Ohio River Basin Model Sector No.	SIC	Industry Title	1960 (Actual)	1970	1980	1990	2000	2010
1.	A (01-09)	Agriculture, Forestry & Fisheries	4,510.4	4,691.8	4,753.7	5,213.7	5,722.3	6,505.9
2.	B (11, 12)	Coal Mining	1,391.1	2,028.2	2,862.6	3,913.3	5,147.4	6,697.3
3.	B (10, 13, 14)	Other Mining (Metals, Crude Oil, Minerals)	1,066.7	1,499.1	2,049.3	2,713.8	3,705.8	4,980.0
4.	C (15, 16, 17)	Construction	7,174.1	10,712.8	15,529.9	21,786.4	31,520.0	42,760.0
5.	D (20)	Food & Kindred Products	6,390.9	8,772.7	11,865.5	15,832.2	21,558.7	29,003.0
6.	D (22)	Textile Mill Products	232.3	318.3	425.5	550.5	749.8	997.5
7.	D (23)	Apparel & Finished Products	696.9	979.4	1,341.8	1,806.6	2,480.7	3,361.2
8.	D (24, 25)	Lumber & Wood Products, Furn. & Fix.	1,185.3	1,646.3	2,239.5	2,988.5	4,095.1	5,493.1
9.	D (26)	Paper & Allied Products	1,246.9	1,822.7	2,618.6	3,524.9	4,866.1	6,575.0
10.	D (27)	Printing, Publishing & Allied Products	1,308.5	1,911.8	2,731.9	3,689.8	5,093.8	6,920.8
11.	D (28)	Chemicals & Allied Products	3,920.8	6,009.4	8,985.2	12,531.7	17,659.6	24,308.6
12.	D (29)	Petroleum Refining	1,000.4	1,571.8	2,146.7	2,995.0	4,215.3	5,825.5
13.	D (30)	Rubber & Misc. Plastics	834.4	1,219.5	1,746.5	2,384.2	3,335.4	4,549.5
14.	D (32)	Stone, Clay & Glass Products	2,270.9	3,078.8	4,082.9	5,335.5	7,327.4	9,857.5
15.	D (331, 332, 339)	Ferrous Metals	8,348.9	8,930.0	9,307.3	9,967.4	11,245.2	12,837.9
16.	D (333, 334, 335, 336)	Nonferrous Metals	1,284.8	1,791.3	2,436.9	3,188.2	4,296.2	5,713.3
17.	D (34)	Fabricated Metal Products	3,370.9	4,796.1	6,518.3	8,821.8	12,269.4	16,669.8
18.	D (35)	Machinery, except Electrical	4,029.9	6,121.6	9,038.7	12,108.0	16,442.0	21,792.4
19.	D (36)	Electrical Machinery	4,504.0	7,140.0	10,998.4	15,319.9	21,888.3	29,825.4
20.	D (37, excl. 371)	Transportation Equipment	1,469.7	2,362.7	3,738.6	5,039.0	6,812.7	9,465.1
21.	D (371)	Motor Vehicles	3,347.1	5,283.3	8,070.5	11,197.7	15,593.2	21,516.4
22.	D (21, 31)	Tobacco & Leather Products	1,209.0	1,669.0	2,237.7	2,958.3	3,910.8	5,303.3
23.	D (19, 38, 39)	Ordnance, Instruments & Misc. Mfg.	749.1	1,145.8	1,712.0	2,349.2	3,251.6	4,443.6
24.	E (40-49)	Transp., Commun., & Utilities	6,432.9	8,674.3	11,924.5	16,003.8	22,179.6	30,164.3
25.	F (50-59)	Trade (wholesale & retail)	10,090.0	14,888.5	21,386.6	28,656.7	39,804.0	54,286.7
26.	G (60-67)	Finance, Insurance & Real Estate	8,757.5	13,723.3	21,084.6	29,685.4	41,579.5	57,474.4
27.	H (70-89)	Services	8,869.3	12,837.8	18,068.2	25,102.6	34,070.1	49,334.6

*These gross output projections are obtained by multiplying the "equilibrium" employment projections presented in this Appendix by projected productivity levels for each industry sector, presented in Appendix F.

TABLE III

PROJECTIONS OF PERSONAL INCOME, POPULATION, AND PER CAPITA PERSONAL INCOME, OHIO RIVER BASIN

Years (1)	Total Personal Income (millions of 1960 dollars) (2)	Total Basin "Equilibrium" Population (000) (3)	Basin Population as Percent of U.S. Population (4)	Per Capita Personal Income in the Basin (in 1960 dollars) (5)
1960 (actual)	37,769.1	19,001	10.6	1,988
1970	55,233.5	20,573	9.9	2,685
1980	78,586.2	23,062	9.4	3,408
1990	108,639.0	25,814	9.0	4,209
2000	152,311.4	28,614	8.7	5,323
2010	211,533.4	31,595	8.4	6,695

Notes:

(2) See accompanying text for detailed explanations.

(3) See Chapter IV, Sections A and C, for detailed explanations. Also refer to accompanying text.

(4) Basin population, shown in Column 3, as percent of Census Bureau, Series III, national population projections. For national projections, see Appendix C.

(5) Column 2 divided by column 3.

APPENDIX I

ALLOCATION OF EMPLOYMENT, POPULATION AND OUTPUT AMONG THE SUBAREAS OF THE OHIO RIVER BASIN

The subarea employment, population and output estimates presented in Chapter II are based on an analysis of subarea shares of each Ohio River Basin industry. We regressed subarea percent shares of Basin employment in each industry against the log of time to get an equation for projecting subarea employment shares. The equations were of the form $y_{xi} = a_{xi} + b_{xi} \log t$, where y_{xi} is the share which subarea x has of employment in Basin industry i, t is time, and a_{xi} and b_{xi} are regression coefficients. We used the log of time in our projection equations to dampen historical trends. Tables I-1 to I-24 give the subarea shares obtained by this method. Although the tables include historical data only for 1950 and 1960, most of the regressions were based on at least three historical shares obtained from the Census of Population, 1940, 1950 and 1960. We also used data from the 1930 Census when available. In addition, data from County Business Patterns for 1956, 1959, and 1962 were incorporated wherever practicable.

For any one industry the same sources and the same years were used in determining the shares of all 19 subareas, to insure that the sum of the projected shares would equal 100%. Since subarea shares are interrelated and the share any one subarea has of the Ohio River Basin is related to the shares of all other subareas, the regression equations from the same sources for 19 subareas reflect the changing distribution of employment in any industry among the subareas. Although use of the log of time permitted us to project the changes in the subarea distribution of an industry at a slower rate for future years than for the historical period for which data points were available, the dampening effect was not always sufficient to prevent projected shares of historically declining subareas from reaching negative values. Since a negative share is impossible and we could not assume that an industry would disappear from a subarea, we adjusted negative shares by substituting a small positive share (generally less than 0.5%). We then revised the shares of all 19 subareas so that their total would equal 100%.

Projected employment shares were used to distribute both employment and output. An exception to this procedure was made for coal mining, for which a separate projected distribution of output was available (Table I-3). A discussion of the allocation procedure for certain industries requiring special treatment follows.

Mining

The projected subarea shares of coal mining and other mining were not obtained by regression of the historical shares against the log of time. Instead, the distribution of coal reserves in 1960 was used as a benchmark estimate of the 2010 distribution of both production and employment in coal mining. We interpolated between 1960 and 2010 to get the distributions for intervening years. The 1960 distribution of coal production was obtained from data on actual mine output, while the 1960 distribution of employment in coal mining was obtained from an estimate of mandays, as computed from production data and productivity estimates in the several subareas.

The future subarea distribution of other mining was projected on the basis of a modified extrapolation of changes in the distribution between 1954 and 1958. Thus, the 1970 shares represent the 1958 shares plus one-half the change between 1954 and 1958; the 1980 shares are the 1970 shares plus one-fourth the 1954-58 change; and the 1990 shares are the 1980 shares plus one-eighth the 1954-58 change. The 2000 and 2010 distributions are the same as the 1990 distribution. Subarea shares of coal mining and other mining are shown in Tables I-2, I-3, and I-4.

Primary Metals (SIC 33)

No information was available on this industry for 1940, so we used data from County Business Patterns for 1956, 1959 and 1962 to supplement data from the Census of Population for 1950 and 1960. Because of discrepancies between these two data sources, the projections resulting from the least-squares regressions had to be adjusted in 7 of the subareas. The adjustments took the form of an extrapolation of the change in share that had occurred between 1950 and 1960, but at a diminishing rate. Further minor adjustments in the remaining subarea shares were then made to insure that the sum of subarea shares would equal 100 percent. In Table I-7, the subareas shares requiring the procedural change described above are identified by an asterisk.

Fabricated Metals (SIC 34)

For the fabricated metals industry only 1950 and 1960 Census data were available. Because data from County Business Patterns was not comparable to the census data, we decided to project subarea shares from linear extrapolations of the 1950-1960 shares against the log of time (Table I-8).

Machinery, except Electrical (SIC 35) and Electrical Machinery (SIC 36)

Shares of these two industries were projected together because we could not satisfactorily distinguish between the two industries in 1950 due to changes in the SIC code. For the combined industries, subarea shares could be computed for 1940, 1950 and 1960, and these were regressed against the log of time to obtain the projected shares presented in Table I-9.

Other Nondurables

Industries grouped in this category include: Paper and Allied Products, SIC 26; Petroleum and Coal Products, SIC 29; Rubber and Miscellaneous Plastics Products, SIC 30; Tobacco Manufactures, SIC 21; and Leather and Leather Products, SIC 31. We projected "Other Nondurables" from census data for 1940, 1950 and 1960. The only data on individual industries in this group can be found in County Business Patterns, 1956, 1959, and 1962. This information was used to allocate projected employment and output in each subarea's "Other Nondurables" category among the component industries according to trends in the component industries revealed by the 1956, 1959 and 1962 data.

The 1940, 1950 and 1956 data were adjusted for the SIC change in Petroleum and Coal Products, in which coke ovens (old SIC 293) were reclassified under SIC 33, Primary Metals. The distribution of "Other Nondurables" among subareas is given in Table I-18, while that of the component industries is given in Table I-19.

Nonclassified

This category, which the Census Bureau uses as a residual for employment in industries that could not be classified in the designated SIC industry groups, is used in this study as a residual to absorb minor adjustments made in the other industry sectors after subarea employment totals had been computed.

As a last step, the computed subarea industry shares were applied to the relevant Basin industry totals to obtain the subarea employment and output figures which are presented in Chapter II (Tables II-5 and II-6). To proceed from total subarea employment to a derivation of total subarea population, the following computations were needed:

Unemployment. Basin unemployment was distributed among the subareas as follows:

(1) It was assumed that by 2010 all subareas would have the same rate of unemployment, i.e., that the unemployment distribution among subareas would correspond to the

employment distribution, so that the ratio of a subarea's unemployment share to its employment share in 2010 would equal one.

(2) We found the 1960 ratio of each subarea's unemployment share to its employment share, and interpolated between this ratio in 1960 and the assumed 2010 ratio (1.0) to get ratios for the intervening years.

(3) We multiplied the subarea employment distributions in each of the projection years by the ratios found in (2) above to obtain projected unemployment distributions among the subareas.

(4) We applied the unemployment distributions found in (3) to total Basin unemployment to get projected unemployment totals for each subarea.

Civilian Labor Force, Armed Forces and Total Labor Force. After unemployment for each subarea had been computed, this figure was added to total employment to get subarea civilian labor force. The Armed Forces projected for the Ohio River Basin were distributed among the subareas according to their 1960 distribution. Total Labor Force is the sum of Civilian Labor Force and Armed Forces.

Population. The subarea population projections were obtained by a method which parallels that used for deriving subarea unemployment:

(1) It was assumed that by 2010 all subareas would have the same relationship between total labor force and population, i.e., that the population distribution among subareas would correspond to the labor force distribution, and hence the ratio of a subarea's population share to its labor force share in 2010 would equal one.

(2) We found the 1960 ratio of each subarea's population share to its labor force share, and interpolated between this ratio in 1960 and that in 2010 (1.0) to get ratios for intervening years.

(3) We multiplied the subarea labor force distributions in each of the projection years by the ratios found in (2) above, thus obtaining projected population distributions among the subareas.

(4) The projected population distributions found in (3) were applied to the total projected Basin population to give the population in each of the subareas for the projection years.

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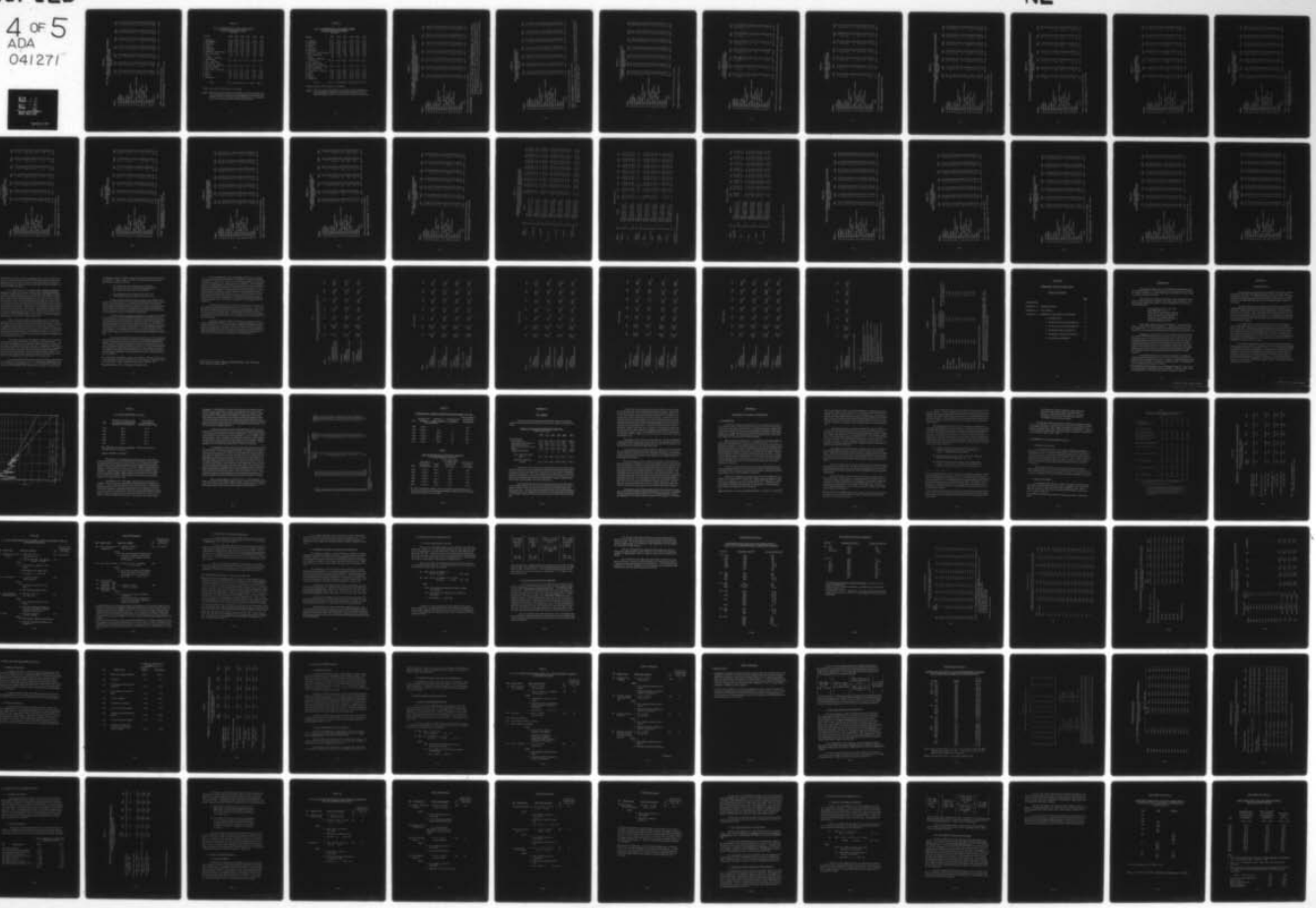


TABLE I-1

SIC 01-09, AGRICULTURE, FORESTRY, AND FISHERIES
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	2.71	2.96	2.76	2.72	2.69	2.67	2.64
B Monongahela	2.31	1.93	1.82	1.69	1.58	1.49	1.41
C Pittsburgh	1.59	1.84	1.66	1.65	1.65	1.64	1.63
D Beaver	1.04	1.45	1.22	1.17	1.12	1.08	1.04
E Upper Ohio	2.79	2.13	2.26	2.17	2.08	2.01	1.95
F Muskingum	5.05	5.43	5.42	5.51	5.58	5.65	5.71
G Kanawha - Little Kanawha	6.07	4.45	4.64	4.35	4.11	3.90	3.72
H Ohio - Huntington	3.14	2.63	2.59	2.48	2.39	2.31	2.24
I Scioto	4.45	5.14	4.98	5.09	5.19	5.27	5.34
J Guyandot - Big Sandy - Little Sandy	2.11	.89	.93	.61	.33	.09	.03
K Ohio - Cincinnati	3.62	3.69	3.73	3.77	3.81	3.84	3.87
L Little Miami - Miami	5.49	6.69	6.49	6.72	6.92	7.09	7.23
M Licking - Kentucky - Salt	11.03	11.09	11.40	11.50	11.59	11.66	11.73
N Ohio - Louisville	2.79	2.83	2.86	2.89	2.91	2.94	2.95
O Lower Ohio - Evansville	5.31	4.62	4.78	4.75	4.73	4.71	4.70
P Green	7.08	7.17	7.43	7.55	7.65	7.73	7.81
Q White	8.20	8.44	8.35	8.38	8.40	8.42	8.44
R Wabash	12.05	14.04	13.72	14.10	14.42	14.70	14.95
S Cumberland	13.13	12.58	12.91	12.86	12.81	12.77	12.73
Total*	99.96	100.00	99.95	99.96	99.99	99.97	100.00

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1930, 1940, 1950 and 1960.

TABLE I-2

SIC 12, BITUMINOUS COAL AND LIGNITE MINING
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1960	1970	1980	1990	2000	2010
A Allegheny	9.00	8.57	8.14	7.71	7.28	6.85
B Monongahela	14.48	13.37	12.26	11.15	10.04	8.93
C Pittsburgh	6.92	6.52	6.13	5.73	5.34	4.94
D Beaver	1.22	1.26	1.30	1.34	1.38	1.42
E Upper Ohio	4.02	4.83	5.65	6.46	7.28	8.09
F Muskingum	4.22	4.53	4.83	5.14	5.45	5.76
G Kanawha - Little Kanawha	15.05	13.33	11.61	9.84	8.16	6.44
H Ohio - Huntington	.78	.98	1.18	1.38	1.58	1.78
I Scioto	.03	.04	.05	.06	.07	.08
J Guyandot - Big Sandy - Little Sandy	24.47	21.61	18.75	15.88	13.02	10.16
K Ohio - Cincinnati	--	--	--	--	--	--
L Little Miami - Miami	--	--	--	--	--	--
M Licking - Kentucky - Salt	6.59	5.63	4.80	3.90	3.01	2.11
N Ohio - Louisville	--	--	--	--	--	--
O Lower Ohio - Evansville	2.72	4.15	5.58	7.01	8.44	9.87
P Green	4.01	4.19	4.37	4.55	4.73	4.91
Q White	1.64	2.42	3.20	3.97	4.75	5.53
R Wabash	.72	4.94	9.16	13.37	17.59	21.81
S Cumberland	4.11	3.52	2.99	2.49	1.88	1.32
Total*	99.98	99.89	100.00	99.90	100.00	100.00

* Totals do not equal 100.00% because of rounding.

Source: 1960 is the percent distribution of mandays in 1960, as computed from coal production data (Bureau of Mines Yearbook 1960) and productivity estimates; 2010 is the estimated percent distribution of coal production (based on 1960 reserves); 1970 to 2000 are interpolated.

TABLE I-3

SIC 12, BITUMINOUS COAL AND LIGNITE MINING
SUBAREA PRODUCTION SHARES
(Percent)

Subarea	1960	1970	1980	1990	2000	2010
A Allegheny	6.79	6.80	6.81	6.83	6.84	6.85
B Monongahela	14.02	13.00	11.98	10.97	9.95	8.93
C Pittsburgh	6.32	6.04	5.77	5.49	5.22	4.94
D Beaver	1.45	1.44	1.44	1.43	1.43	1.42
E Upper Ohio	4.99	5.61	6.23	6.85	7.47	8.09
F Muskingum	6.16	6.08	6.00	5.92	5.84	5.76
G Kanawha - Little Kanawha	11.49	10.48	9.47	8.46	7.45	6.44
H Ohio - Huntington	.82	1.01	1.20	1.40	1.59	1.78
I Scioto	.03	.04	.05	.06	.07	.08
J Guyandot - Big Sandy - Little Sandy	24.16	21.36	18.56	15.76	12.96	10.16
K Ohio - Cincinnati	--	--	--	--	--	--
L Little Miami - Miami	--	--	--	--	--	--
M Licking - Kentucky - Salt	4.58	4.09	3.59	3.10	2.60	2.11
N Ohio - Louisville	--	--	--	--	--	--
O Lower Ohio - Evansville	4.42	5.51	6.60	7.69	8.78	9.87
P Green	7.99	7.37	6.76	6.14	5.53	4.91
Q White	1.64	2.42	3.20	3.97	4.75	5.53
R Wabash	1.74	5.75	9.77	13.78	17.80	21.81
S Cumberland	3.41	2.99	2.57	2.16	1.74	1.32
Total*	100.01	99.99	100.00	100.01	100.02	100.00

*Totals do not equal 100.00% because of rounding.

Source: 1960 is the percent distribution of coal production based on Bureau of Mines Yearbook for 1960; 2010 is the estimated distribution of coal production based on 1960 coal reserves; 1970 to 2000 are interpolated.

TABLE I-4

SIC 10, METAL MINING, SIC 13, CRUDE PETROLEUM AND NATURAL GAS, AND SIC 14, MINING AND QUARRYING OF NON-METALLIC MINERALS
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1954	1958	1970	1980	1990	2000	2010
A Allegheny	14.17	9.05	6.50	5.19	4.49	4.49	4.49
B Monongahela	3.67	2.96	2.61	2.41	2.29	2.29	2.29
C Pittsburgh	6.50	4.66	3.75	3.27	3.00	3.00	3.00
D Beaver	4.42	1.98	.76	.76	.75	.75	.75
E Upper Ohio	6.16	6.07	6.03	5.97	5.87	5.87	5.87
F Muskingum	8.00	6.86	6.30	5.98	5.75	5.75	5.75
G Kanawha - Little Kanawha	8.09	7.88	7.79	7.68	7.55	7.55	7.55
H Ohio - Huntington	3.95	5.48	6.26	6.61	6.72	6.72	6.72
I Scioto	3.10	2.99	2.94	2.89	2.83	2.83	2.83
J Guyandot - Big Sandy - Little Sandy	3.82	4.74	5.21	5.41	5.46	5.46	5.46
K Ohio - Cincinnati	1.13	1.06	1.02	1.00	.97	.97	.97
L Little Miami - Miami	2.07	2.25	2.35	2.38	2.38	2.38	2.38
M Licking - Kentucky - Salt	2.57	3.57	4.08	4.30	4.37	4.37	4.37
N Ohio - Louisville	1.67	2.08	2.30	2.39	2.42	2.42	2.42
O Lower Ohio - Evansville	7.41	11.54	13.64	14.58	14.90	14.90	14.90
P Green	2.07	2.82	3.21	3.38	3.43	3.43	3.43
Q White	7.58	8.65	9.21	9.42	10.42	10.42	10.42
R Wabash	11.84	13.02	13.64	13.86	13.82	13.82	13.82
S Cumberland	1.77	2.13	2.41	2.53	2.57	2.57	2.57
Total*	99.99	99.97	100.01	100.01	99.99	99.99	99.99

*Totals do not equal 100.00% because of rounding.

Source and Procedure: 1954 and 1958 were calculated from Census of Mineral Industries, vol. II, Area Statistics, for those years; 1970 is 1958 plus one-half the change from 1954 to 1958; 1980 is 1970 plus one-fourth the change from 1954 to 1958; 1990 is 1980 plus one-eighth the change from 1954 to 1958; 2000 and 2010 equal 1990. (An exception to this procedure was made for Subarea D, Beaver, whose 1970 share was kept constant in subsequent projection years to avoid projecting a negative share.)

TABLE I-5

SIC 15-17, CONTRACT CONSTRUCTION
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	3.79	3.46	3.56	3.44	3.34	3.27	3.19
B Monongahela	2.85	2.47	2.62	2.61	2.59	2.58	2.57
C Pittsburgh	13.38	11.95	11.39	10.92	10.52	10.18	9.88
D Beaver	3.76	4.26	3.86	3.87	3.88	3.89	3.89
E Upper Ohio	3.52	3.58	3.37	3.30	3.24	3.19	3.15
F Muskingum	4.92	5.28	5.04	5.02	5.00	4.99	4.97
G Kanawha - Little Kanawha	5.31	4.17	4.99	5.07	5.15	5.20	5.26
H Ohio - Huntington	2.85	2.98	3.04	3.06	3.09	3.11	3.13
I Scioto	5.86	6.93	6.62	6.72	6.81	6.87	6.94
J Guyandot - Big Sandy - Little Sandy	1.24	1.19	1.31	1.34	1.36	1.38	1.39
K Ohio - Cincinnati	7.41	7.75	6.90	6.56	6.27	6.02	5.80
L Little Miami - Miami	6.43	7.12	6.70	6.69	6.69	6.68	6.68
M Licking - Kentucky - Salt	4.16	4.29	4.60	4.77	4.91	5.04	5.15
N Ohio - Louisville	4.83	4.94	5.08	5.11	5.15	5.18	5.21
O Lower Ohio - Evansville	3.25	3.26	3.56	3.63	3.70	3.75	3.80
P Green	1.97	2.07	2.31	2.46	2.58	2.68	2.77
Q White	9.20	9.79	9.64	9.66	9.68	9.68	9.70
R Wabash	7.44	6.85	7.42	7.45	7.46	7.49	7.51
S Cumberland	7.83	7.58	8.00	8.32	8.58	8.82	9.02
Total*	100.00	99.92	100.01	100.00	100.00	100.00	100.01

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1930, 1940, 1950 and 1960.

Note: The subarea employment shares in this table do not correspond exactly to the distribution of construction employment shown in Table II-5 (Chapter II), due to minor revisions in productivity made subsequent to the computation of subarea employment shares.

TABLE I-6

SIC 24 AND 25, LUMBER AND FURNITURE
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	4.85	5.04	5.07	5.13	5.18	5.23	5.25
B Monongahela	3.40	3.50	3.27	3.17	3.08	3.01	2.94
C Pittsburgh	2.56	3.40	2.36	1.96	1.62	1.33	1.08
D Beaver	4.65	3.86	5.27	5.87	6.39	6.83	7.22
E Upper Ohio	2.73	2.14	2.28	2.24	2.20	2.17	2.15
F Muskingum	2.67	3.45	3.31	3.39	3.46	3.52	3.57
G Kanawha - Little Kanawha	9.84	9.76	9.42	9.20	9.03	8.87	8.75
H Ohio - Huntington	3.09	2.84	3.25	3.43	3.58	3.71	3.82
I Scioto	2.20	2.67	2.31	2.21	2.11	2.04	1.98
J Guyandot - Big Sandy - Little Sandy	3.05	2.39	1.66	1.13	.67	.29	.05
K Ohio - Cincinnati	6.29	6.59	6.13	5.92	5.75	5.61	5.49
L Little Miami - Miami	3.40	4.00	3.48	3.32	3.18	3.07	2.96
M Licking - Kentucky - Salt	3.31	3.12	4.13	4.46	4.76	5.02	5.23
N Ohio - Louisville	8.95	7.57	7.85	7.70	7.61	7.51	7.43
O Lower Ohio - Evansville	6.08	6.22	5.94	5.80	5.70	5.61	5.53
P Green	2.36	2.66	2.91	3.10	3.26	3.40	3.52
Q White	12.09	12.62	12.56	12.60	12.67	12.73	12.76
R Wabash	6.84	6.72	6.93	7.00	7.07	7.14	7.19
S Cumberland	11.65	11.45	12.11	12.40	12.68	12.91	13.11
Total*	100.01	100.00	100.24	100.03	100.00	100.00	100.03

* Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1940, 1950 and 1960.

TABLE I-7

SIC 33, PRIMARY METALS
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	5.70	6.16	6.23	6.36	6.48	6.58	6.67
B Monogahela	.89	1.36	1.69*	1.97*	2.16*	2.24*	2.29*
C Pittsburgh	41.24	37.90	37.44	36.13	35.09	34.18	33.41
D Beaver	18.05	17.87	17.06*	16.87*	16.71*	16.59*	16.53*
E Upper Ohio	9.26	9.85	9.96*	10.28*	10.52*	10.66*	10.72*
F Muskingum	7.11	7.06	7.92*	7.88*	7.84*	7.82*	7.80*
G Kanawha - Little Kanawha	.62	.80	.92*	1.03*	1.11*	1.16*	1.18*
H Ohio - Huntington	3.03	4.37	3.47	3.59	3.70	3.77	3.85
I Scioto	1.17	1.24	1.12*	1.12*	1.11*	1.10*	1.10*
J Guyandot - Big Sandy - Little Sandy	.03	.08	.12	.14	.17	.19	.21
K Ohio-Cincinnati	1.95	1.26	.77*	.42*	.17*	.10*	.09*
L Miami - Little Miami	3.66	3.83	4.34	4.57	4.75	4.90	5.04
M Licking - Kentucky - Salt	.03	.12	.15	.19	.23	.27	.28
N Ohio - Louisville	.66	.34	.40	.35	.30	.27	.24
O Lower Ohio - Evansville	.13	.29	.36	.43	.49	.55	.60
P Green	.01	.10	.16	.22	.26	.30	.32
Q White	2.56	2.67	2.74	2.83	2.91	2.99	3.04
R Wabash	3.71	4.57	5.07	5.53	5.92	6.24	6.54
S Cumberland	.19	.15	.10	.10	.10	.09	.09
Total*	100.00	100.02	100.02	100.01	100.02	100.00	100.00

*Totals do not equal 100.00% because of rounding. Starred shares were not estimated from regression analysis.

Source: Census of Population, 1950 and 1960, County Business Patterns, 1956, 1959 and 1962.

TABLE I-8

SIC 34, FABRICATED METALS
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	3.34	5.05	5.96	6.57	7.05	7.42	7.75
B Monongahela	1.42	1.45	1.30	1.21	1.12	1.06	1.01
C Pittsburgh	17.87	18.66	18.82	18.93	19.01	19.06	19.13
D Beaver	9.61	8.09	7.10	6.40	5.87	5.44	5.09
E Upper Ohio	5.36	4.68	4.21	3.90	3.66	3.47	3.31
F Muskingum	10.39	9.37	10.25	10.21	10.19	10.15	10.14
G Kanawha - Little Kanawha	.87	.84	.43	.43	.42	.41	.41
H Ohio - Huntington	.86	.57	.24	.22	.22	.22	.22
I Scioto	7.64	7.05	6.61	6.29	6.04	5.95	5.70
J Guyandot - Little Sandy - Big Sandy	.04	.06	.08	.09	.10	.10	.10
K Ohio - Cincinnati	7.46	8.62	9.15	9.52	9.80	10.02	10.22
L Miami - Little Miami	7.53	8.32	8.65	8.88	9.06	9.18	9.30
M Licking - Kentucky - Salt	.32	.82	.91	1.09	1.25	1.37	1.49
N Ohio - Louisville	6.84	6.26	5.83	5.53	5.30	5.12	4.96
O Lower Ohio - Evansville	.16	2.22	3.37	4.16	4.76	5.23	5.64
P Green	.06	.14	.18	.21	.24	.27	.29
Q White	10.87	9.77	8.96	8.41	7.99	7.65	7.37
R Wabash	6.12	5.13	4.48	4.04	3.70	3.41	3.18
S Cumberland	1.75	2.89	3.49	3.91	4.23	4.47	4.70
Total*	100.01	99.99	100.02	100.00	100.01	100.00	100.01

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1950 and 1960.

TABLE I-9

SIC 35 AND 36, MACHINERY (EXCEPT ELECTRICAL) AND ELECTRICAL MACHINERY
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	4.06	3.77	4.34	4.60	4.82	5.01	5.18
B Monongahela	.57	.86	.94	1.05	1.13	1.21	1.28
C Pittsburgh	13.43	12.01	9.83	8.33	7.06	5.96	4.99
D Beaver	6.07	5.25	5.23	5.06	4.91	4.78	4.66
E Upper Ohio	1.28	1.59	1.54	1.58	1.61	1.64	1.66
F Muskingum	9.54	8.54	9.65	10.06	10.40	10.70	10.97
G Kanawha - Little Kanawha	.47	.76	.79	.86	.92	.98	1.03
H Ohio - Huntington	.55	.40	.47	.48	.49	.50	.51
I Scioto	5.30	7.20	7.59	8.20	8.71	9.15	9.53
J Guyandot - Big Sandy - Little Sandy	.09	.12	.13	.14	.15	.15	.16
K Ohio - Cincinnati	7.90	6.68	5.07	3.93	2.96	2.12	1.39
L Little Miami - Miami	21.37	17.85	16.53	15.08	13.85	12.79	11.85
M Licking - Kentucky - Salt	.35	1.96	2.20	2.67	3.06	3.40	4.00
N Ohio - Louisville	2.93	4.43	5.15	5.86	6.46	6.98	7.43
O Lower Ohio - Evansville	5.60	3.25	3.02	2.42	1.91	1.46	1.07
P Green	.13	.56	.62	.74	.85	.94	1.02
Q White	15.04	16.12	17.51	18.51	19.34	20.07	20.71
R Wabash	4.83	7.01	7.59	8.35	9.00	9.55	10.04
S Cumberland	.49	1.64	1.78	2.09	2.35	2.58	2.78
Total*	100.00	100.00	99.98	100.01	99.98	99.97	100.26

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1940, 1950 and 1960.

TABLE I-10

SIC 37 (EXCEPT 371), TRANSPORTATION EQUIPMENT (EXCEPT MOTOR VEHICLES)
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	2.39	2.55	2.12	1.90	1.73	1.56	1.39
B Monongahela	.48	.34	.47	.51	.54	.56	.57
C Pittsburgh	26.99	11.63	10.57	6.86	3.79	1.16	.46
D Beaver	7.42	7.26	3.89	2.01	.46	.19	.09
E Upper Ohio	.33	.23	.13	.11	.09	.07	.05
F Muskingum	3.64	3.42	3.02	2.73	2.50	2.28	2.05
G Kanawha - Little Kanawha	.10	.27	.24	.24	.26	.27	.27
H Ohio - Huntington	2.44	2.41	2.38	2.25	2.13	2.00	1.84
I Scioto	8.71	16.25	19.11	22.03	24.46	26.25	27.32
J Guyandot - Big Sandy - Little Sandy	.00	.06	.02	.01	.01	.01	.01
K Ohio - Cincinnati	4.16	6.82	6.80	7.29	7.68	7.94	8.02
L Little Miami - Miami	11.87	13.85	14.54	15.23	15.78	16.10	16.09
M Licking - Kentucky - Salt	.61	.63	.59	.59	.58	.57	.55
N Ohio - Louisville	1.87	1.16	.38	.29	.19	.10	.05
O Lower Ohio - Evansville	1.48	1.65	1.42	1.31	1.23	1.14	1.06
P Green	.05	.04	.06	.08	.08	.09	.09
Q White	25.55	25.54	29.11	30.84	32.28	33.16	33.35
R Wabash	1.34	3.00	1.94	2.02	2.09	2.13	2.12
S Cumberland	1.20	2.91	3.24	3.73	4.15	4.45	4.63
Total*	100.63	100.02	100.03	100.03	100.03	100.03	100.01

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1940, 1950 and 1960.

TABLE I-11

SIC 371, MOTOR VEHICLES
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	.32	.47	.52	.56	.60	.63	.66
B Monongahela	.94	.29	.68	.76	.83	.89	.94
C Pittsburgh	3.08	3.61	3.84	4.04	4.20	4.34	4.46
D Beaver	1.94	2.44	2.91	3.24	3.51	3.75	3.94
E Upper Ohio	.25	.27	.22	.21	.19	.18	.17
F Muskingum	2.66	7.17	7.33	8.25	9.01	9.66	10.22
G Kanawha - Little Kanawha	.11	.21	.21	.22	.23	.25	.26
H Ohio - Huntington	1.15	1.04	1.55	1.79	1.99	2.15	2.30
I Scioto	6.58	4.54	6.16	6.57	6.91	7.20	7.45
J Guyandot - Big Sandy - Little Sandy	.07	.17	.21	.25	.28	.32	.33
K Ohio - Cincinnati	11.43	13.20	14.65	15.65	16.50	17.19	17.80
L Little Miami - Miami	23.71	18.71	15.91	13.26	11.08	9.23	7.63
M Licking - Kentucky - Salt	.19	.77	.85	1.01	1.13	1.23	1.35
N Ohio - Louisville	3.72	3.58	3.23	2.99	2.78	2.61	2.46
O Lower Ohio - Evansville	4.11	1.14	.25	.20	.14	.10	.05
P Green	.05	.44	.49	.59	.68	.75	.81
Q White	30.48	28.86	27.09	25.57	24.32	23.27	22.35
R Wabash	9.41	11.93	12.61	13.38	14.01	14.54	15.00
S Cumberland	.64	1.14	1.30	1.46	1.61	1.73	1.83
Total*	100.84	99.98	100.01	100.00	100.00	100.02	100.01

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1940, 1950 and 1960.

TABLE I-12

SIC 19, 32, 38 AND 39, OTHER DURABLES
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	7.53	7.81	7.90	8.05	8.18	8.29	8.38
B Monongahela	6.16	5.56	5.08	4.64	4.27	3.95	3.66
C Pittsburgh	16.25	14.17	13.86	13.20	12.64	12.15	11.72
D Beaver	4.85	4.00	4.33	4.20	4.08	3.98	3.89
E Upper Ohio	10.07	7.57	6.16	4.71	3.48	2.42	1.49
F Muskingum	13.47	12.61	11.48	10.66	9.96	9.36	8.83
G Kanawha - Little Kanawha	2.44	2.84	2.51	2.41	2.33	2.26	2.20
H Ohio - Huntington	2.75	2.88	2.66	2.55	2.45	2.37	2.30
I Scioto	6.26	7.58	8.57	9.04	9.43	9.78	10.08
J Guyandot - Big Sandy - Little Sandy	.52	.62	.44	.40	.37	.34	.31
K Ohio - Cincinnati	6.61	6.38	8.85	10.10	11.16	12.08	12.88
L Little Miami - Miami	4.20	4.56	5.48	6.29	6.97	7.56	8.08
M Licking - Kentucky - Salt	.53	1.47	1.60	1.86	2.09	2.28	2.46
N Ohio - Louisville	1.95	2.27	2.74	3.01	3.23	3.43	3.60
O Lower Ohio - Evansville	1.45	1.16	1.06	1.06	1.06	1.07	1.07
P Green	.16	.31	.34	.38	.42	.45	.48
Q White	8.40	8.84	8.27	8.20	8.14	8.09	8.04
R Wabash	5.12	6.20	5.60	5.67	5.72	5.77	5.82
S Cumberland	1.26	3.21	3.36	3.93	4.41	4.83	5.20
Total*	99.98	100.04	100.29	100.36	100.39	100.46	100.49

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1940, 1950 and 1960;
County Business Patterns, 1956, 1959 and 1962.

TABLE I-13

SIC 20, FOOD
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	3.14	2.79	2.76	2.66	2.58	2.51	2.44
B Monongahela	1.58	1.60	1.19	1.11	1.05	.99	.94
C Pittsburgh	14.10	13.41	12.19	11.65	11.19	10.79	10.44
D Beaver	2.25	2.60	2.48	2.50	2.52	2.54	2.56
E Upper Ohio	2.42	2.47	1.97	1.83	1.71	1.61	1.51
F Muskingum	3.83	5.05	5.31	5.65	5.94	6.19	6.41
G Kanawha - Little Kanawha	2.01	2.20	1.97	1.98	2.00	2.01	2.02
H Ohio - Huntington	1.51	1.75	1.56	1.59	1.61	1.62	1.64
I Scioto	6.61	6.40	7.36	7.49	7.59	7.68	7.76
J Guyandot - Big Sandy - Little Sandy	.52	.54	.37	.34	.31	.29	.27
K Ohio - Cincinnati	12.50	11.26	13.46	13.79	14.06	14.30	14.51
L Little Miami - Miami	5.34	6.49	6.10	6.16	6.22	6.27	6.31
M Licking - Kentucky - Salt	3.65	3.92	3.75	3.82	3.89	3.94	3.99
N Ohio - Louisville	9.03	8.61	9.61	9.84	10.03	10.20	10.35
O Lower Ohio - Evansville	4.75	3.95	3.86	3.70	3.56	3.44	3.33
P Green	1.00	1.40	.95	.97	.99	1.01	1.03
Q White	12.36	12.30	12.51	12.41	12.32	12.25	12.18
R Wabash	8.18	7.72	6.51	6.09	5.74	5.44	5.17
S Cumberland	5.20	5.54	6.09	6.42	6.70	6.94	7.15
Total*	99.98	100.00	100.00	100.00	100.01	100.02	100.01

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1940, 1950 and 1960;
County Business Patterns, 1956, 1959 and 1962.

TABLE I-14

SIC 22, TEXTILES
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	3.40	1.12	1.03	.54	.15	.09	.04
B Monongahela	.97	1.38	1.27	1.27	1.26	1.25	1.23
C Pittsburgh	5.10	2.60	2.81	2.40	2.06	1.77	1.53
D Beaver	.69	1.79	1.97	2.26	2.46	2.61	2.74
E Upper Ohio	3.36	.46	1.24	.09	.05	.02	.01
F Muskingum	1.94	1.33	1.62	1.64	1.64	1.63	1.63
G Kanawha - Little Kanawha	24.29	31.65	34.63	37.20	38.84	40.04	41.03
H Ohio - Huntington	.69	.87	1.01	1.12	1.19	1.24	1.28
I Scioto	4.90	6.18	6.14	6.29	6.34	6.37	6.38
J Guyandot - Big Sandy - Little Sandy	.00	.00	.00	.00	.00	.00	.00
K Ohio - Cincinnati	6.60	6.33	6.50	6.45	6.36	6.26	6.17
L Little Miami - Miami	4.70	10.21	8.32	8.31	8.21	8.10	8.00
M Licking - Kentucky - Salt	1.82	.61	.94	.86	.80	.74	.69
N Ohio - Louisville	5.06	3.06	2.49	1.79	1.21	.75	.35
O Lower Ohio - Evansville	6.03	7.50	7.61	7.86	7.98	8.05	8.11
P Green	.40	1.94	1.95	2.22	2.42	2.57	2.69
Q White	11.21	2.91	.97	.47	.23	.11	.05
R Wabash	1.94	.97	1.06	.92	.79	.68	.60
S Cumberland	16.88	19.04	18.42	18.30	18.02	17.73	17.48
Total*	99.62	99.95	99.98	99.98	100.01	100.01	100.01

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1940, 1950 and 1960.

TABLE I-15

SIC 23, APPAREL
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	6.67	7.62	9.74	10.85	11.75	12.21	12.57
B Monongahela	2.99	3.57	4.44	5.01	5.47	5.72	5.93
C Pittsburgh	3.94	3.22	3.21	3.10	2.99	2.84	2.69
D Beaver	1.65	1.18	.56	.18	.07	.04	.02
E Upper Ohio	1.54	1.68	1.48	1.47	1.48	1.46	1.43
F Muskingum	2.19	1.72	1.67	1.65	1.63	1.57	1.52
G Kanawha - Little Kanawha	3.30	7.18	9.02	10.44	11.60	12.28	12.83
H Ohio - Huntington	3.64	2.36	2.39	2.16	1.97	1.77	1.59
I Scioto	2.67	1.94	1.20	.86	.59	.34	.14
J Guyandot - Big Sandy - Little Sandy	.24	.81	.98	1.15	1.30	1.40	1.47
K Ohio - Cincinnati	12.50	7.53	5.95	3.40	1.28	.57	.28
L Little Miami - Miami	4.66	2.25	1.34	.72	.20	.10	.05
M Licking - Kentucky - Salt	7.39	7.66	9.37	10.41	11.25	11.68	12.01
N Ohio - Louisville	5.16	3.85	3.04	2.27	1.61	1.03	.54
O Lower Ohio - Evansville	3.82	3.03	2.28	1.82	1.42	1.07	.76
P Green	5.35	7.73	9.27	10.71	11.88	12.57	13.12
Q White	8.73	5.60	3.35	1.68	.28	.10	.05
R Wabash	10.16	7.48	5.74	4.19	2.90	1.73	.78
S Cumberland	13.41	23.57	25.02	27.94	30.33	31.55	32.52
Total*	100.06	99.98	100.02	100.01	100.00	100.03	100.30

*Totals do not equal 100.00% because of rounding.

Sources: Census of Population, 1940, 1950 and 1960;
County Business Patterns, 1956, 1959 and 1962.

TABLE I-16

SIC 27, PRINTING AND PUBLISHING
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	2.80	2.76	2.79	2.80	2.81	2.82	2.82
B Monongahela	1.37	1.47	1.38	1.35	1.32	1.30	1.28
C Pittsburgh	11.43	11.42	11.06	10.86	10.69	10.54	10.41
D Beaver	2.54	3.00	3.19	3.39	3.56	3.71	3.84
E Upper Ohio	3.10	3.03	3.09	3.11	3.12	3.14	3.15
F Muskingum	5.39	5.14	4.83	4.61	4.43	4.26	4.12
G Kanawha - Little Kanawha	2.30	2.28	2.44	2.52	2.59	2.65	2.71
H Ohio - Huntington	1.36	1.45	1.29	1.28	1.26	1.25	1.24
I Scioto	6.32	6.89	6.92	7.05	7.16	7.26	7.34
J Guyandot - Big Sandy - Little Sandy	.40	.50	.55	.59	.63	.67	.70
K Ohio - Cincinnati	13.66	12.04	10.92	9.98	9.17	8.48	7.89
L Little Miami - Miami	13.32	12.94	12.96	12.89	12.83	12.78	12.74
M Licking - Kentucky - Salt	1.50	1.71	1.73	1.78	1.83	1.86	1.90
N Ohio - Louisville	6.45	5.99	6.17	6.17	6.18	6.18	6.19
O Lower Ohio - Evansville	1.96	1.93	1.87	1.84	1.80	1.78	1.75
P Green	.55	.58	.95	.98	1.00	1.02	1.04
Q White	10.41	10.63	10.44	10.37	10.32	10.28	10.24
R Wabash	9.04	9.51	10.57	11.26	11.84	12.34	12.78
S Cumberland	6.09	6.74	7.08	7.40	7.68	7.91	8.12
Total*	99.99	100.01	100.23	100.23	100.22	100.23	100.24

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1940, 1950 and 1960.

TABLE I-17

SIC 28, CHEMICAL AND ALLIED PRODUCTS
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	3.80	2.37	.76	.56	.30	.20	.10
B Monongahela	2.49	.63	.27	.11	.07	.05	.03
C Pittsburgh	9.44	8.71	8.05	7.91	7.78	7.57	7.34
D Beaver	1.30	1.34	1.28	1.29	1.31	1.30	1.29
E Upper Ohio	5.88	6.86	3.26	1.79	.54	.25	.10
F Muskingum	1.95	1.90	2.28	2.35	2.41	2.43	2.43
G Kanawha - Little Kanawha	22.44	19.62	19.71	19.25	18.86	18.26	17.64
H Ohio - Huntington	2.77	4.79	3.24	3.53	3.77	3.92	4.03
I Scioto	2.55	3.71	4.26	4.61	4.91	5.09	5.22
J Guyandot - Big Sandy - Little Sandy	.28	.25	.30	.33	.34	.35	.37
K Ohio - Cincinnati	14.48	14.59	14.99	14.71	14.47	14.07	13.63
L Little Miami - Miami	3.04	3.86	2.13	1.73	1.39	1.08	.81
M Licking - Kentucky - Salt	.38	.29	.87	.94	.99	1.03	1.06
N Ohio -Louisville	7.23	8.17	12.16	13.66	14.74	15.55	16.14
O Lower Ohio - Evansville	1.00	3.65	3.30	3.90	4.41	4.79	5.08
P Green	.14	.25	.64	.76	.87	.95	1.00
Q White	9.72	9.69	12.73	13.78	14.67	15.23	15.60
R Wabash	3.19	4.66	5.70	6.51	7.20	7.68	8.05
S Cumberland	7.93	4.67	3.60	2.28	1.17	.20	.10
Total*	100.01	100.01	99.53	100.00	100.20	100.00	100.02

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1940, 1950 and 1960.

TABLE I-18

SIC 21, 26, 29, 30, 31, OTHER NONDURABLES
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	5.20	4.70	2.69	1.87	1.18	.58	.06
B Monongahela	1.46	.51	.52	.40	.30	.21	.13
C Pittsburgh	4.66	5.30	3.62	2.83	2.16	1.59	1.09
D Beaver	2.07	2.95	2.63	2.67	2.69	2.72	2.73
E Upper Ohio	1.67	2.26	1.72	1.50	1.31	1.16	1.02
F Muskingum	8.15	8.89	10.19	10.78	11.26	11.70	12.08
G Kanawha - Little Kanawha	1.22	1.28	.68	.54	.42	.32	.23
H Ohio - Huntington	4.69	4.02	2.56	2.20	1.90	1.64	1.41
I Scioto	7.93	8.43	8.69	8.85	8.97	9.09	9.19
J Guyandot - Big Sandy - Little Sandy	.15	.21	.24	.27	.29	.33	.34
K Ohio - Cincinnati	10.96	9.30	9.89	9.43	9.04	8.71	8.43
L Little Miami - Miami	13.37	15.47	17.29	18.12	18.81	19.42	19.96
M Licking - Kentucky - Salt	1.35	1.77	2.39	2.77	3.07	3.35	3.59
N Ohio - Louisville	7.50	6.94	8.32	8.69	9.09	9.25	9.48
O Lower Ohio - Evansville	2.16	2.41	2.18	2.15	2.14	2.13	2.12
P Green	.48	.51	.38	.39	.40	.41	.41
Q White	10.15	9.19	9.17	9.23	9.28	9.34	9.38
R Wabash	9.82	9.20	8.95	8.96	8.95	8.95	8.96
S Cumberland	7.01	6.67	7.90	8.38	8.77	9.12	9.42
Total*	100.00	100.01	100.01	100.03	100.03	100.02	100.03

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1940, 1950 and 1960.

TABLE I-19

DISTRIBUTION OF "OTHER NONDURABLES" EMPLOYMENT INTO THE COMPONENT INDUSTRIES, SIC 26, 29, 30, 21 AND 31 BY SUBAREA

(Percent of "Other Nondurables" Employment)

	Subarea	SIC	Industry	1956	1959	1962	1970	1980	1990	2000	2010
A	Allegheny	26	Paper	18.44	18.89	17.99	18.44	18.44	18.44	18.44	18.44
		29	Petroleum and Coal Prods.	46.30	49.98	43.73	46.67	46.67	46.67	46.67	46.67
		30	Rubber and Misc. Plastics	19.94	18.87	16.13	15.50	15.00	14.50	14.00	13.50
		21 & 31	Tobacco Prods. and Leather	15.32	12.26	22.15	19.39	19.89	20.39	20.89	21.39
B	Monongahela	26	Paper	13.36	37.63	37.31	37.40	37.40	37.40	37.40	37.40
		29	Petroleum and Coal Prods.	72.90	22.58	22.39	22.20	22.10	22.00	21.90	21.80
		30	Rubber and Misc. Plastics	-	-	-	-	-	-	-	-
		21 & 31	Tobacco Prods. and Leather	13.74	39.78	40.30	40.40	40.50	40.60	40.70	40.80
C	Pittsburgh	26	Paper	59.48	60.33	61.28	61.50	61.70	61.90	62.10	62.30
		29	Petroleum and Coal Prods.	35.70	14.52	9.59	8.50	7.50	6.50	5.50	4.50
		30	Rubber and Misc. Plastics	2.49	23.44	29.13	30.00	30.80	31.60	32.40	33.20
		21 & 31	Tobacco Prods. and Leather	2.33	1.71	-	-	-	-	-	-
D	Beaver	26	Paper	6.67	10.64	16.11	18.10	19.00	19.50	20.00	20.50
		29	Petroleum and Coal Prods.	18.62	18.05	5.94	4.90	4.00	3.50	3.00	2.50
		30	Rubber and Misc. Plastics	47.55	54.88	64.89	67.00	68.00	68.50	69.00	69.50
		21 & 31	Tobacco Prods. and Leather	27.16	16.43	13.06	10.00	9.00	8.50	8.00	7.50
E	Upper Ohio	26	Paper	63.91	52.43	38.69	30.00	23.75	20.50	17.50	14.50
		29	Petroleum and Coal Prods.	6.53	7.22	7.37	8.00	8.25	8.50	8.75	9.00
		30	Rubber and Misc. Plastics	6.65	10.20	14.75	17.00	18.00	18.50	18.75	19.00
		21 & 31	Tobacco Prods. and Leather	22.91	30.15	39.19	45.00	50.00	52.50	55.00	57.50
F	Muskingum	26	Paper	39.89	39.43	31.98	25.00	20.00	16.50	14.50	13.50
		29	Petroleum and Coal Prods.	3.71	5.19	6.14	9.00	11.00	12.50	13.50	14.25
		30	Rubber and Misc. Plastics	56.40	55.37	61.88	66.00	69.00	71.00	72.00	72.25
		21 & 31	Tobacco Prods. and Leather	-	-	-	-	-	-	-	-
G	Kanawha - Little Kanawha	26	Paper	-	-	-	-	-	-	-	-
		29	Petroleum and Coal Prods.	31.19	26.16	26.32	26.00	26.00	26.00	26.00	26.00
		30	Rubber and Misc. Plastics	-	24.61	18.42	19.00	19.00	19.00	19.00	19.00
		21 & 31	Tobacco Prods. and Leather	68.81	49.23	55.26	55.00	55.00	55.00	55.00	55.00

TABLE I-19 (Cont'd.)

	Subarea	SIC	Industry	1956	1959	1962	1970	1980	1990	2000	2010
H	Ohio -	26	Paper	-	-	-	-	-	-	-	-
	Huntington	29	Petroleum and Coal Prods.	40.59	32.09	33.98	30.00	27.00	25.00	24.00	23.50
		30	Rubber and Misc. Plastics	14.85	18.97	13.49	14.00	14.00	14.00	14.00	14.00
		21 & 31	Tobacco Prods. and Leather	44.55	48.94	52.53	56.00	59.00	61.00	62.00	62.50
I	Scioto	26	Paper	41.25	52.41	52.82	57.00	59.00	60.00	60.50	60.75
		29	Petroleum and Coal Prods.	2.04	1.17	1.51	1.50	1.50	1.50	1.50	1.50
		30	Rubber and Misc. Plastics	4.27	13.58	16.56	20.00	23.00	24.00	24.50	24.75
		21 & 31	Tobacco Prods. and Leather	52.13	32.84	29.11	21.50	16.50	14.50	13.50	13.00
J	Guyandot -	26	Paper	n.a.*	-	n.a.	-	-	-	-	-
	Big Sandy -	29	Petroleum and Coal Prods.	n.a.	100.00**	n.a.	100.00	100.00	100.00	100.00	100.00
	Little Sandy	30	Rubber and Misc. Plastics	n.a.	-	n.a.	-	-	-	-	-
		21 & 31	Tobacco Prods. and Leather	n.a.	-	n.a.	-	-	-	-	-
K	Ohio -	26	Paper	51.02	41.27	44.55	44.00	43.00	42.50	42.25	42.00
	Cincinnati	29	Petroleum and Coal Prods.	13.26	11.18	10.47	8.00	7.00	6.50	6.25	6.00
		30	Rubber and Misc. Plastics	2.18	18.22	21.11	29.00	33.00	35.00	36.00	37.00
		21 & 31	Tobacco Prods. and Leather	33.54	29.32	23.88	19.00	17.00	16.00	15.50	15.00
L	Little Miami -	26	Paper	62.31	54.18	58.37	58.29	58.29	58.29	58.29	58.29
	Miami	29	Petroleum and Coal Prods.	1.55	1.36	1.19	1.37	1.37	1.37	1.37	1.37
		30	Rubber and Misc. Plastics	34.02	43.82	39.36	39.07	39.07	39.07	39.07	39.07
		21 & 31	Tobacco Prods. and Leather	2.12	0.65	1.09	1.29	1.29	1.29	1.29	1.29
M	Licking -	26	Paper	-	3.52	5.01	5.01	5.01	5.01	5.01	5.01
	Kentucky -	29	Petroleum and Coal Prods.	-	-	-	-	-	-	-	-
	Salt	30	Rubber and Misc. Plastics	-	27.74	33.94	33.94	33.94	33.94	33.94	33.94
		21 & 31	Tobacco Prods. and Leather	100.00	68.74	61.04	61.04	61.04	61.04	61.04	61.04
N	Ohio -	26	Paper	10.13	10.69	15.47	19.00	22.00	24.00	25.00	25.50
	Louisville	29	Petroleum and Coal Prods.	1.85	2.21	2.08	2.05	2.05	2.05	2.05	2.05
		30	Rubber and Misc. Plastics	-	1.21	1.77	2.20	2.70	3.20	3.70	4.20
		21 & 31	Tobacco Prods. and Leather	88.02	85.90	80.68	76.75	73.25	70.75	69.25	68.25

*Not available

**Estimated from 1958 Census of Manufactures

TABLE I-19 (Cont'd.)

	Subarea	SIC	Industry	1956	1959	1962	1970	1980	1990	2000	2010
O	Lower Ohio - Evansville	26	Paper	21.31	20.33	11.50	7.50	4.50	3.00	2.00	1.50
		29	Petroleum and Coal Prods.	10.08	6.29	5.64	3.00	2.00	1.50	1.25	1.00
		30	Rubber and Misc. Plastics	10.08	27.73	45.38	62.50	71.50	76.50	79.75	81.50
		21 & 31	Tobacco Prods. and Leather	58.53	45.65	37.48	27.00	22.00	19.00	17.00	16.00
P	Green	26	Paper	-	27.99	36.84	36.00	36.00	36.00	36.00	36.00
		29	Petroleum and Coal Prods.	-	-	-	-	-	-	-	-
		30	Rubber and Misc. Plastics	-	-	-	-	-	-	-	-
		21 & 31	Tobacco Prods. and Leather	100.00	72.01	63.16	64.00	64.00	64.00	64.00	64.00
Q	White	26	Paper	51.89	50.71	47.65	45.00	44.00	43.50	43.00	42.50
		29	Petroleum and Coal Prods.	3.49	3.10	3.52	3.37	3.37	3.37	3.37	3.37
		30	Rubber and Misc. Plastics	29.01	37.71	36.39	39.45	40.45	40.95	41.45	41.95
		21 & 31	Tobacco Prods. and Leather	15.61	8.49	12.44	12.18	12.18	12.18	12.18	12.18
R	Wabash	26	Paper	31.71	24.76	26.01	27.49	27.49	27.49	27.49	27.49
		29	Petroleum and Coal Prods.	13.59	9.23	9.25	10.69	10.69	10.69	10.69	10.69
		30	Rubber and Misc. Plastics	17.67	39.34	38.86	37.82	38.32	38.82	39.32	39.82
		21 & 31	Tobacco Prods. and Leather	37.04	26.67	25.89	24.00	23.50	23.00	22.50	22.00
S	Cumberland	26	Paper	7.08	9.48	8.66	8.41	8.41	8.41	8.41	8.41
		29	Petroleum and Coal Prods.	-	2.26	2.32	2.50	2.75	3.00	3.25	3.50
		30	Rubber and Misc. Plastics	5.14	14.15	10.14	10.20	10.30	10.40	10.50	10.60
		21 & 31	Tobacco Prods. and Leather	87.78	74.11	78.88	78.89	78.54	78.19	77.84	77.49

Source: County Business Patterns, 1956, 1959 and 1962.

TABLE I-20

SIC 40-49, TRANSPORTATION, COMMUNICATIONS AND UTILITIES
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	4.00	4.01	4.05	4.03	4.06	4.07	4.08
B Monongahela	3.47	3.37	3.47	3.46	3.51	3.52	3.54
C Pittsburgh	15.87	14.68	15.85	15.91	16.17	16.30	16.41
D Beaver	4.19	4.40	4.30	4.29	4.33	4.35	4.36
E Upper Ohio	3.68	3.62	3.65	3.62	3.64	3.64	3.65
F Muskingum	4.86	4.89	4.88	4.86	4.91	4.91	4.91
G Kanawha - Little Kanawha	4.76	4.54	4.73	4.72	4.77	4.78	4.79
H Ohio - Huntington	4.57	3.94	4.25	4.92	4.23	4.22	4.21
I Scioto	6.06	6.12	5.92	5.79	5.75	5.69	5.64
J Guyandot - Big Sandy - Little Sandy	1.73	1.56	1.55	1.51	1.49	1.46	1.43
K Ohio - Cininnnati	7.81	8.26	7.72	7.51	7.44	7.33	7.23
L Little Miami - Miami	4.61	5.39	5.07	5.09	5.18	5.23	5.27
M Licking - Kentucky - Salt	2.44	2.57	2.39	2.32	2.30	2.26	2.24
N Ohio - Louisville	5.30	5.46	5.48	5.46	5.50	5.51	5.51
O Lower Ohio - Evansville	3.09	3.21	3.15	3.15	3.19	3.20	3.21
P Green	1.05	1.15	1.11	1.13	1.16	1.17	1.18
Q White	9.16	9.61	9.27	9.22	9.30	9.32	9.32
R Wabash	7.98	7.73	7.56	7.37	7.32	7.23	7.14
S Cumberland	5.37	5.48	5.60	5.64	5.75	5.82	5.88
Total*	100.00	99.99	100.00	100.00	100.00	100.01	100.00

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1930, 1940, 1950 and 1960.

TABLE I-21

SIC 50-59, TRADE
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	3.92	3.83	3.79	3.74	3.70	3.67	3.64
B Monongahela	2.84	2.63	2.70	2.68	2.66	2.65	2.64
C Pittsburgh	14.39	13.20	13.07	12.70	12.39	12.11	11.87
D Beaver	4.33	4.44	4.43	4.46	4.49	4.51	4.53
E Upper Ohio	3.82	3.70	3.70	3.65	3.61	3.57	3.54
F Muskingum	5.41	5.44	5.46	5.49	5.52	5.54	5.56
G Kanawha - Little Kanawha	4.12	4.00	4.31	4.44	4.56	4.66	4.75
H Ohio - Huntington	2.64	2.54	2.58	2.58	2.58	2.59	2.59
I Scioto	6.22	6.51	6.37	6.38	6.40	6.41	6.42
J Guyandot - Big Sandy - Little Sandy	1.52	1.36	1.52	1.56	1.59	1.63	1.65
K Ohio - Cincinnati	8.30	7.76	7.64	7.44	7.28	7.13	7.01
L Little Miami - Miami	6.77	7.36	7.15	7.21	7.26	7.30	7.34
M Licking - Kentucky - Salt	2.81	3.15	3.13	3.19	3.24	3.28	3.32
N Ohio - Louisville	4.81	4.75	4.70	4.67	4.64	4.62	4.59
O Lower Ohio - Evansville	3.25	3.16	3.28	3.31	3.33	3.35	3.37
P Green	1.41	1.68	1.67	1.73	1.79	1.85	1.88
Q White	10.09	10.75	10.61	10.69	10.76	10.82	10.87
R Wabash	7.80	7.69	7.79	7.78	7.78	7.77	7.77
S Cumberland	5.56	6.03	6.12	6.30	6.44	6.56	6.67
Total*	100.01	99.98	100.02	100.00	100.02	100.02	100.01

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1930, 1940, 1950 and 1960.

TABLE I-22

SIC 60-67, FINANCE, INSURANCE AND REAL ESTATE
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	2.93	2.78	2.76	2.72	2.69	2.66	2.63
B Monongahela	1.93	1.76	1.72	1.68	1.65	1.62	1.60
C Pittsburgh	17.65	15.80	16.24	15.90	15.62	15.38	15.15
D Beaver	3.60	3.80	3.66	3.66	3.66	3.66	3.66
E Upper Ohio	2.80	2.73	2.66	2.57	2.48	2.41	2.35
F Muskingum	4.33	4.78	4.69	4.73	4.77	4.80	4.83
G Kanawha - Little Kanawha	2.93	2.39	2.79	2.87	2.93	2.99	3.04
H Ohio - Huntington	1.93	1.95	1.84	1.81	1.78	1.75	1.73
I Scioto	8.66	8.39	8.69	8.87	9.01	9.14	9.25
J Guyandot- Big Sandy - Little Sandy	.67	.59	.63	.66	.68	.70	.72
K Ohio - Cincinnati	10.86	10.19	10.56	10.45	10.36	10.28	10.21
L Little Miami - Miami	6.33	7.02	6.73	6.79	6.84	6.89	6.93
M Licking - Kentucky - Salt	2.27	2.58	2.46	2.52	2.57	2.61	2.65
N Ohio - Louisville	6.06	6.00	5.95	5.91	5.87	5.84	5.81
O Lower Ohio - Evansville	2.60	2.49	2.47	2.47	2.47	2.47	2.47
P Green	.73	1.02	.94	.99	1.02	1.05	1.08
Q White	12.13	13.07	12.90	13.03	13.14	13.24	13.33
R Wabash	6.00	6.19	5.94	5.83	5.74	5.66	5.59
S Cumberland	5.60	6.48	6.38	6.57	6.74	6.88	7.01
Total*	100.01	100.01	100.01	100.03	100.02	100.03	100.04

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1930, 1940, 1950 and 1960.

TABLE I-23

SIC 70-89, SERVICES
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	4.05	3.76	3.81	3.76	3.71	3.68	3.65
B Monongahela	3.02	2.64	2.71	2.65	2.61	2.57	2.53
C Pittsburgh	13.14	12.95	12.50	12.25	12.06	11.89	11.73
D Beaver	3.93	4.18	4.05	4.09	4.13	4.16	4.18
E Upper Ohio	3.46	3.36	3.27	3.20	3.13	3.08	3.03
F Muskingum	4.92	4.97	4.90	4.90	4.91	4.91	4.91
G Kanawha - Little Kanawha	4.52	4.20	4.47	4.53	4.57	4.60	4.63
H Ohio - Huntington	2.41	2.37	2.33	2.32	2.30	2.28	2.27
I Scioto	6.31	7.17	8.11	8.34	8.54	8.71	8.85
J Guyandot - Big Sandy - Little Sandy	1.47	1.36	1.43	1.43	1.43	1.43	1.43
K Ohio - Cincinnati	7.84	7.20	7.10	6.94	6.80	6.68	6.57
L Little Miami - Miami	6.53	7.47	7.07	7.17	7.25	7.33	7.40
M Licking - Kentucky - Salt	3.98	4.02	4.00	4.00	4.00	4.00	4.01
N Ohio - Louisville	5.00	4.65	4.63	4.59	4.55	4.52	4.50
O Lower Ohio - Evansville	3.07	2.92	2.94	2.92	2.91	2.90	2.89
P Green	1.56	1.60	1.64	1.66	1.68	1.70	1.71
Q White	9.57	9.85	9.57	9.59	9.61	9.63	9.64
R Wabash	8.48	8.43	8.47	8.55	8.62	8.67	8.73
S Cumberland	6.72	6.90	7.01	7.11	7.20	7.28	7.35
Total*	99.98	100.00	100.01	100.00	100.01	100.02	100.01

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1930, 1940, 1950 and 1960.

TABLE I-24

SIC 90-94, GOVERNMENT
SUBAREA EMPLOYMENT SHARES
(Percent)

Subarea	1950	1960	1970	1980	1990	2000	2010
A Allegheny	2.79	2.54	1.91	1.58	1.29	1.06	.84
B Monongahela	2.13	2.03	1.85	1.72	1.62	1.52	1.44
C Pittsburgh	12.39	11.74	8.59	7.17	5.98	4.95	4.04
D Beaver	3.03	3.08	2.76	2.66	2.58	2.51	2.45
E Upper Ohio	2.70	2.69	2.62	2.55	2.50	2.46	2.41
F Muskingum	4.07	4.02	3.96	3.92	3.89	3.87	3.85
G Kanawha - Little Kanawha	3.93	3.75	4.17	4.27	4.36	4.43	4.49
H Ohio - Huntington	2.22	1.99	2.06	2.02	2.00	1.97	1.95
I Scioto	9.32	9.17	9.43	9.57	9.70	9.80	9.90
J Guyandot - Big Sandy - Little Sandy	1.04	1.09	1.06	1.07	1.07	1.07	1.07
K Ohio - Cincinnati	6.81	7.02	6.87	6.80	6.74	6.69	6.64
L Little Miami - Miami	13.01	13.69	15.08	16.27	17.27	18.13	18.89
M Licking - Kentucky - Salt	4.02	4.25	4.59	4.83	5.03	5.20	5.35
N Ohio - Louisville	5.58	4.96	5.34	5.47	5.58	5.68	5.76
O Lower Ohio - Evansville	2.46	2.22	2.23	2.17	2.11	2.06	2.02
P Green	1.56	1.79	2.47	2.49	2.51	2.53	2.53
Q White	10.26	11.55	11.75	12.03	12.27	12.47	12.65
R Wabash	6.67	6.28	6.86	6.84	6.82	6.81	6.80
S Cumberland	6.01	6.13	6.40	6.57	6.70	6.82	6.92
Total*	100.00	99.99	100.00	100.00	100.02	100.03	100.00

*Totals do not equal 100.00% because of rounding.

Source: Census of Population, 1930, 1940, 1950 and 1960.

APPENDIX J

GENERATION AND CONSUMPTION OF ELECTRIC POWER IN THE OHIO RIVER BASIN AND ITS SUBAREAS

Chapter V presented estimates of net generation of electric power by government and investor-owned utilities operating in the Ohio River Basin.* This appendix gives a detailed description of the procedures used to estimate net generation. Table I summarizes the results for the Basin and for each subarea. Generating capacity is given for 1950 and 1960 only. Net generation, power purchased and the ratio of net generation to consumption are given at decennial intervals from 1950 to 2010. The ratio of net generation to consumption is higher than one or lower than one according to whether a subarea is estimated to export or to import power. Since coal is by far the major source of fuel for electric power generation in the Basin, it is not surprising that the subareas which are shown to be power exporters are the ones which include the principal coal deposits in the Basin.

Historical data on net generation is available on a plant-by-plant basis from publications of the Federal Power Commission.** We determined which plants are located in the Ohio River Basin and then compiled information on net generation for the years 1950 and 1960. Future levels of net generation were projected on the basis of estimated consumption requirements within the region and estimated power exports, taking into consideration likely changes in the technology and economics of power production. We estimated historical power consumption in the Ohio River Basin in order to obtain a relationship between generation and consumption for use in projecting net generation from future consumption requirements. Our estimates of future power consumption are related to the projected economic development of the Basin.

Both historical and projected power consumption in the Basin was computed as the sum of subarea consumption. Electric power consumption was computed separately for manufacturing industries and for all other consumers.

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*According to the Edison Electrical Institute, the generating capacity of sources other than the electric utility industry was 10% of that of the utilities in 1960, and 20% in 1950. These nonutility sources include industrial, mine and railway electric power plants (Statistical Yearbook, 1960, p. 5).

**Hydroelectric Plant Construction Cost and Annual Production Expenses, 1960 and 1961, and Steam-Electric Plant Construction Cost and Annual Production Expenses, 1950, 1960 and 1961.

The purpose of singling out the manufacturing customers of the electric utilities was to enable us to incorporate our detailed information about the region's industrial structure into the computations of per capita power consumption. Table II illustrates the difference in per capita power purchases among the ten states in the Ohio River Basin.

It is evident that the inter-regional range of manufacturing power purchases per capita is much greater than the range of all power purchases per capita. Regional differences in per capita power consumption are attributable to such factors as personal income levels, the price of power, climate, and the availability of competing energy sources, as well as an area's industrial structure. Since we have detailed data on the industrial structure of the Basin and its subareas, it was decided to estimate future power sales to industrial consumers of electricity separately from the derivation of power sales to all non-industrial consumers. In doing this, it was possible to make allowances for differences in the rate of industrial power consumption resulting from differences in the industry mix in the subareas. Instead of assuming that power purchased per manufacturing employee is the same in a given subarea as it is in the entire state, we assumed that the power used per employee in a particular industry is the same in the subarea and the state.

Power consumed by manufacturing industries in each subarea was computed as the sum of power consumed by individual industries. We multiplied employment in each industry by a relevant state ratio of power purchased per employee in that industry to obtain power purchased by the industry. We assigned each subarea industry to a given state so as to enable us to determine both historical and projected power consumption per employee. The state ratio chosen was generally that of the state in which the subarea (or the major part of the subarea) is located. If this ratio was either unavailable or inappropriate, we used another state's ratio.

For example, electricity consumption per employee in the Kentucky chemical industry was not used for all the subareas located in Kentucky. The state ratio is so high that its use might have produced excessive estimates of total power consumption in subareas J, M, and P. Although these subareas are located in Kentucky, they do not have chemical plants whose power consumption characteristics are comparable with those of plants situated along the Ohio River which determine the state ratio of power purchased per employee. We therefore used the West Virginia ratio for chemicals in subareas J, M, and P, since this ratio appeared more representative of local power use.

We computed 1950 and 1960 state ratios from data on purchased power and employment, as reported in the 1947 and 1958 Census of Manufactures and the 1960 Annual Survey of Manufactures. For those industries for which 1960 state data was not available, power purchased per employee was estimated by

multiplying the 1960 U.S. industry ratio by the percent which the state ratio had been of the U.S. ratio in 1958. For 1950, we estimated state industry power purchased per employee as follows:

1. We estimated the percent which the state ratio had been of the U.S. ratio in 1950 by interpolating between the values of this percentage in 1947 and 1958;

2. We multiplied the percent found in (1) by the U. S. ratio in 1950 to get the estimated state ratio in 1950.

We then estimated future state power purchases per employee by industry from past growth rates. We dampened historical growth rates to project industry ratios which had already reached extremely high levels and which seemed unlikely to continue to grow as rapidly as in the past. Our projected increases in power purchased per employee compare well with the productivity increases that were used to derive employment projections from the gross output projections generated by the Ohio River Basin model.

In deriving subarea nonmanufacturing power consumption, we assumed that consumption per capita approximates that given for the state in which the subarea is located. (It did not appear as important to distinguish subarea from state nonmanufacturing consumption per capita as it had been to distinguish the manufacturing ratios, because the nonmanufacturing ratios are more uniform between states and are therefore likely to be more uniform within any given state than industrial per capita power consumption.) For subareas which overlap state boundaries, we assumed that each portion of subarea population in a particular state would have that state's per capita nonmanufacturing power consumption.

We computed nonmanufacturing power purchases for each state by subtracting manufacturing purchases, as reported in the Annual Survey of Manufactures,* from total power sales published by the Edison Electric Institute.** We found subarea nonmanufacturing power purchases by applying state ratios to subarea population and then calculated each subarea's ratio of nonmanufacturing power purchases to population for 1950 and 1960. Future subarea ratios were extrapolated on the basis of 1950-1960 growth; these ratios, when multiplied by projected subarea population, yielded projections of subarea nonmanufacturing power purchases.

*U.S. Department of Commerce, Bureau of the Census, 1960: data on power purchases by industry in Ohio River Basin states; 1950 data was estimated as shown in working papers, entitled "Manufacturing Purchases of Power 1950."

**Statistical Bulletin, 1950, and Statistical Yearbook, 1960.

After computing future power consumption for the Basin, we applied estimates of the ratio of net generation to consumption to obtain net generation (see Table V-6, Chapter V). Projected levels of net generation were distributed among the 19 subareas in the manner discussed in Chapter V. In this Appendix only the 1970 distribution of net generation among subareas needs an explanation because the method of distribution for the subsequent projection years is adequately treated in Chapter V. Net generation for 1970 was estimated on a plant-by-plant basis by multiplying estimated plant capacity by appropriate plant utilization factors and the number of hours in a year. The 1970 capacity of each power plant in the Ohio River Basin was estimated to be the same as it was in 1961 (the latest year for which figures were available) unless planned additions had been reported either by the utilities themselves or by the National Coal Association.*

The plant utilization factor for 1970 was estimated for each plant from past utilization rates of operating plants of the same type and age. In general, the rate for steam plants was decreased by one percentage point per year, since this was borne out by historical data. Hydroelectric plant utilization factors were kept constant at the 1960 level. For new plants, we used a factor suggested by the utility, or one based on the historical utilization factors of new plants operated by that utility.

It should be emphasized that the 1970 estimates of subarea net generation on a plant-by-plant basis were used only to obtain a distribution of net generation among subareas. Current estimates of additions to capacity by 1970 are likely to be conservative; therefore, we based our estimates of total net generation in the Ohio River Basin in 1970 and in the subsequent projections years, not on planned capacity but on our own estimates of consumption requirements and on the ratio of net generation to consumption described in Chapter V.

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*National Coal Association, Steam-Electric Plant Factors, 1961, Washington, D.C., July 1962, Tables 4 and 6.

TABLE I

COMPARISON OF ELECTRIC POWER GENERATED AND PURCHASED IN THE OHIO RIVER BASIN AND ITS SUBAREAS, 1950 - 2010

Subarea	1950	1960	1970	1980	1990	2000	2010
A. Allegheny							
1) Capacity (megawatts)	97.8	428.6					
2) Net generation (million kwhr)	703	2,943	19,249	31,271	50,630	83,005	134,906
3) Power purchased (million kwhr)	1,781	2,890	5,104	8,681	14,731	25,439	43,906
4) Net generation/power purchased	.39	1.02	3.77	3.60	3.44	3.26	3.07
B. Monongahela							
1) Capacity	150.0	487.8					
2) Net generation	1,010	3,197	12,466	24,383	47,141	91,679	175,863
3) Power purchased	1,091	1,930	3,320	5,561	9,157	15,272	25,389
4) Net generation/power purchased	.93	1.66	3.75	4.38	5.15	6.00	6.93
C. Pittsburgh SMSA							
1) Capacity	1,201.0	2,149.1					
2) Net generation	7,588	10,458	18,103	28,025	42,830	65,416	97,326
3) Power purchased	6,436	10,180	16,066	27,076	42,874	72,625	122,650
4) Net generation/power purchased	1.18	1.03	1.13	1.07	1.00	.90	.79

TABLE I (Continued)

Subarea	1950	1960	1970	1980	1990	2000	2010
D. Beaver							
1) Capacity	147.3	630.4					
2) Net generation	1,009	2,626	3,941	6,412	10,468	17,227	28,079
3) Power purchased	3,018	5,836	8,717	14,205	23,526	40,569	70,585
4) Net generation/power purchased	.33	.45	.45	.45	.44	.42	.40
E. Upper Ohio							
1) Capacity	1,115.0	2,412.0					
2) Net generation	7,653	10,701	30,385	46,827	71,224	108,184	159,396
3) Power purchased	2,141	7,614	10,409	15,551	23,518	37,051	58,940
4) Net generation/power purchased	3.57	1.41	2.92	3.01	3.03	2.92	2.70
F. Muskingum							
1) Capacity	431.5	1,642.5					
2) Net generation	2,806	10,003	11,389	20,069	35,441	63,609	113,583
3) Power purchased	2,379	5,448	9,824	16,795	28,932	49,952	86,547
4) Net generation/power purchased	1.18	1.84	1.16	1.19	1.22	1.27	1.31
G. Kanawha - Little Kanawha							
1) Capacity	578.6	1,219.2					
2) Net generation	3,938	6,581	6,645	14,567	30,515	63,007	126,883
3) Power purchased	1,884	4,064	7,225	12,522	20,801	35,021	57,852
4) Net generation/power purchased	2.09	1.62	.92	1.16	1.47	1.79	2.19

TABLE I (Continued)

Subarea	1950	1960	1970	1980	1990	2000	2010
H. Ohio - Huntington							
1) Capacity	250.0	2,146.3					
2) Net generation	1,493	12,100	14,895	20,939	27,915	34,575	35,046
3) Power purchased	1,047	4,075	7,147	12,890	21,939	37,434	62,356
4) Net generation/power purchased	1.43	2.72	2.08	1.62	1.27	.92	.56
I. Scioto							
1) Capacity	123.7	223.7					
2) Net generation	600	147	46	119	342	723	1,478
3) Power purchased	1,565	4,910	9,270	17,075	30,236	53,334	92,869
4) Net generation/power purchased	.38	.03	.004	.01	.01	.01	.02
J. Guyandot - Big Sandy - Little Sandy							
1) Capacity	90.4	90.4					
2) Net generation	614	172	2,337	12,429	35,920	88,788	200,142
3) Power purchased	508	866	1,412	2,228	3,579	5,784	9,406
4) Net generation/power purchased	1.21	.20	1.66	5.58	10.04	15.35	21.28
K. Ohio - Cincinnati							
1) Capacity	550.0	1,746.0					
2) Net generation	2,775	8,333	19,363	28,025	39,067	52,285	62,703
3) Power purchased	2,405	10,553	16,811	27,218	43,198	70,126	111,978
4) Net generation/power purchased	1.15	.79	1.15	1.03	.90	.75	.56

TABLE I (Continued)

Subarea	1950	1960	1970	1980	1990	2000	2010
L. Little Miami - Miami							
1) Capacity	483.5	930.5					
2) Net generation	2,009	3,793	4,446	6,927	10,605	16,384	24,490
3) Power purchased	2,590	6,953	11,752	20,550	35,135	60,869	104,888
4) Net generation/power purchased	.78	.55	.38	.34	.30	.27	.23
M. Licking - Kentucky - Salt							
1) Capacity	50.0	200.9					
2) Net generation	376	598	2,017	4,552	9,784	20,480	41,591
3) Power purchased	543	2,197	3,979	6,969	12,705	23,078	42,004
4) Net generation/power purchased	.69	.27	.51	.65	.77	.89	.99
N. Ohio - Louisville							
1) Capacity	372.3	2,498.9					
2) Net generation	1,803	15,053	19,982	28,421	38,520	49,273	53,625
3) Power purchased	2,260	19,410	36,076	55,188	84,211	128,516	191,818
4) Net generation/power purchased	.80	.78	.55	.51	.46	.38	.28
O. Lower Ohio - Evansville							
1) Capacity	252.5	2,703.5					
2) Net generation	1,697	21,548	25,963	42,750	70,267	117,340	194,442
3) Power purchased	1,105	9,155	15,597	27,046	42,807	66,670	100,653
4) Net generation/power purchased	1.54	2.35	1.66	1.58	1.64	1.76	1.93

TABLE I (Continued)

Subarea	1950	1960	1970	1980	1990	2000	2010
P. Green							
1) Capacity	60.0	210.9					
2) Net generation	481	1,394	13,153	21,573	35,304	58,670	96,693
3) Power purchased	271	1,132	2,319	3,564	6,517	11,920	21,609
4) Net generation/power purchased	1.77	1.23	5.67	6.05	5.42	4.92	4.47
Q. White							
1) Capacity	402.5	820.0					
2) Net generation	2,093	3,749	3,552	9,698	22,999	51,321	108,938
3) Power purchased	2,766	5,952	10,797	20,070	35,786	63,856	113,131
4) Net generation/power purchased	.76	.63	.33	.48	.64	.80	.96
R. Wabash							
1) Capacity	304.5	1,127.8					
2) Net generation	2,106	5,282	8,318	30,914	82,103	194,924	429,841
3) Power purchased	2,096	4,391	7,716	14,026	25,206	44,979	80,384
4) Net generation/power purchased	1.00	1.20	1.08	2.20	3.26	4.33	5.35
S. Cumberland							
1) Capacity	142.9	1,703.5					
2) Net generation	514	8,562	12,924	17,971	23,536	28,070	25,968
3) Power purchased	2,045	7,285	12,314	18,238	29,668	49,889	89,799
4) Net generation/power purchased	.25	1.18	1.05	.99	.79	.56	.29

TABLE I (Continued)

Subarea	1950	1960	1970	1980	1990	2000	2010
Total OHIO RIVER BASIN							
1) Capacity	6,803.5	23,372.0					
2) Net generation	41,268	127,240	229,150*	395,831*	684,193*	1,204,720	2,111,203
3) Power purchased	37,931	114,841	195,855	324,452	534,526	892,385	1,486,763
4) Net generation/power purchased	1.09	1.11	1.17	1.22	1.28	1.35	1.42

*Subarea figures do not add up to Basin total due to rounding.

Source: Working papers

1. Capacity, Plant Utilization and Net Generation of Power Plants in the Ohio River Basin, 1950, 1960 and 1970.
2. Power Consumption by Manufacturing Industries Based on Employment in Ohio River Basin Subareas, 1950 and 1960.
3. Power Consumption (excluding Manufacturing) Based on Population, Ohio River Basin Subareas 1950 and 1960.
4. Subarea Power Consumption -- Final Estimates 1970 to 2010.
5. Estimated Ratio of Net Generation to Power Consumption in the Ohio River Basin in Future Years.
6. Percent Distribution of Ohio River Basin Power Production Among Subareas.

TABLE II

PER CAPITA PURCHASES OF ELECTRIC POWER BY STATE, 1960
(million kilowatt-hours)

State	All Power Purchases per 1,000 Persons	All Power Purchases (Except Manufacturing) per 1,000 Persons	Manufacturing Power Purchases per 1,000 Employees
Pennsylvania	3.47	1.93	11.60
Maryland	2.93*	2.10*	10.70*
West Virginia	4.45	0.88	52.67
Ohio	5.90	1.94	29.65
North Carolina	3.33	2.05	11.51
Virginia	2.90	2.10	10.59
Kentucky	9.43	2.37	108.34
Indiana	3.65	1.88	13.53
Illinois	3.29	2.01	10.34
Tennessee	10.44	3.20	81.26

*This figure is for Maryland and the District of Columbia.

Source: All Power Purchases from Edison Electrical Institute Statistical Yearbook, 1960, p. 28; Population and Manufacturing Employment from 1960 Census of Population; Manufacturing Power Purchases from 1960 Annual Survey of Manufactures.

APPENDIX K

INDEPENDENT INDUSTRY PROJECTIONS

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INTRODUCTION

This appendix contains the so-called independent projections which were developed for those Ohio River Basin industries which had been classified as "export" industries, i.e., those which ship a substantial part of their output to customers outside of the Basin.

These industries, which are listed below, make an important contribution to total employment in the Basin and, furthermore, constitute one of the major linkages whereby the region's economic development is affected by national growth trends:

Ferrous Metals (SIC 331, 332, 339)
Coal Mining (SIC 11, 12)
Chemicals and Allied Products (SIC 28)
Stone, Clay and Glass Products (SIC 32)
Fabricated Metal Products (SIC 34)
Machinery, except Electrical (SIC 35)
Electrical Machinery (SIC 36)

These export industries were first identified by a location quotient analysis, which is described in Appendix E-6. Then the volume of each industry's export trade, i.e., the volume of output shipped beyond the Basin (see Table IV-1) was determined by estimating trade coefficients (see Appendix E-6).

Independent projections for the export industries were developed for two reasons: (1) to provide alternative forecasts as checks against the model-derived projections of certain important industry sectors, and (2) to provide independent projection values for the predetermined variables of the model. A means was thereby provided for incorporating into the model the judgment of industry specialists about the effect of technological change upon some of the region's major industry groups. It may therefore be said that the independent industry projections are a product of statistical analysis tempered by specialists' judgment, wherever such judgment could be quantified for projection purposes.*

To the extent that these projections serve as guides in setting the values of predetermined variables, e.g., the Net Trade values (see Net Trade in Chapter IV and Appendix F), they are, of course, no longer independent checks upon our model projections, but rather an independent means of establishing the values of exogenously determined variables.

*The projections of Ferrous Metals and Coal Mining (Appendix K-1 and K-2) have a substantial input of judgment by industry specialists. The other export industries (Appendix K-3) are basically the product of regression analysis.

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APPENDIX K-1

FERROUS METALS

Steel production was projected at the national level in order to provide a yardstick for the Ohio River Basin projection of the ferrous metals industry. Although ferrous metals -- the industry grouping used in the model -- is a somewhat broader category than the narrower definition of steel used in the national projection, the definitional differences are not substantial enough to affect our conclusions.

The national forecast of steel output is the result of a projection of the changing historical relationship that exists between the total demand for steel ingots and castings on the one hand, and total expenditures on durable goods and construction on the other. This relationship, which is shown in Figure 7 and in Table I, reveals a gradual decline since 1929 in the consumption of steel per dollar of durable goods and construction expenditures. By fitting least-square trend lines to the periods 1929-1961 and 1947-1961, constant rates of decline in steel consumption were obtained.

It is evident that the trend line fitted to the post-war period shows a rate of decline that is greater than the rate resulting from a fit to the longer period, 1929-1961. We decided to use the postwar trend line on the premise that it reflects the effect of recent technological developments and that it provides a better indication of future relationships than the line fitted to the longer period. The relatively steady decline in steel consumption per dollar of durable goods and construction expenditures is, of course, the result of long-run changes in the composition of national expenditures on durable goods and construction and the substitution of other materials for steel.

The national steel output projections were derived by relating the post-war trend line shown in Figure 7 to projected levels of durable goods and construction expenditures computed in Appendix C. Thus, U.S. steel production (Table II) is expected to increase from approximately 99 million tons in 1960 to about 220 million tons in 2010, while expenditures on durable goods and construction are estimated to increase from 130 billion dollars to 790 billion dollars, these expenditures being expressed in constant 1954 dollars. A comparison of the projection results shows that expenditures on durable goods and construction will experience a six-fold increase while the output of steel is only expected to double during the forecast period.

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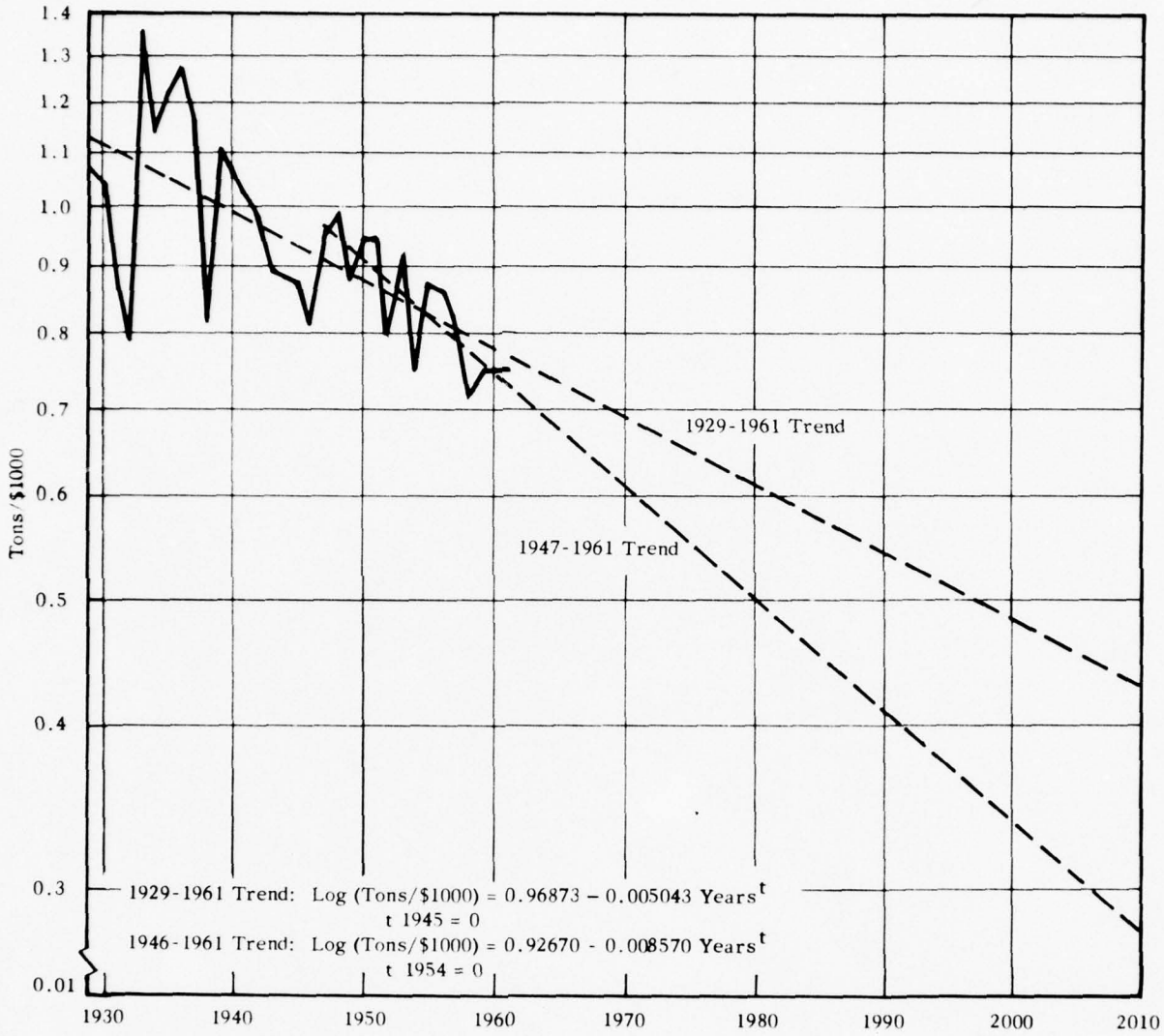
TABLE I

STEEL CONSUMPTION RELATED TO DURABLE GOODS AND CONSTRUCTION EXPENDITURES

Year	Durable Goods Expenditures (Billions of 1954 dollars)	Construction Expenditures (Billions of 1954 dollars)	Durable Goods and Construction Expenditures (Billions of 1954 dollars)	Steel Consumption Per $1,000 of Durable Goods and Construction Expenditures
1929	30.8	26.1	56.9	1.06
1930	20.5	21.8	42.3	1.04
1931	15.0	17.5	32.5	.87
1932	7.6	11.8	19.4	.79
1933	10.6	8.4	19.0	1.35
1934	15.6	9.2	24.8	1.13
1935	19.8	10.9	30.7	1.22
1936	26.2	15.1	41.3	1.27
1937	28.7	16.4	45.1	1.16
1938	19.7	15.3	35.0	.83
1939	25.5	19.0	44.5	1.11
1940	33.1	20.1	53.2	1.06
1941	46.1	26.5	72.6	1.02
1942	50.2	27.8	78.0	.99
1943	73.7	15.4	89.1	.90
1944	82.5	10.4	92.9	.88
1945	72.9	10.8	83.7	.87
1946	53.2	20.8	74.0	.81
1947	55.8	24.3	80.1	.95
1948	55.4	28.2	83.6	.99
1949	51.9	29.7	81.6	.88
1950	65.3	35.4	100.7	.95
1951	74.6	36.0	110.6	.95
1952	75.1	36.9	112.0	.80
1953	80.8	38.8	119.6	.92
1954	71.6	41.6	113.2	.76
1955	83.1	45.6	128.7	.88
1956	84.9	43.9	128.8	.86
1957	85.5	44.0	129.5	.82
1958	71.7	44.5	116.2	.72
1959	82.9	48.3	131.2	.75
1960	84.2	48.1	132.3	.76
1961	81.3	49.2	130.5	.76
1962	91.0	51.4	142.4	**
1963	97.2	52.9	150.1	**
1964	101.9*	55.5*	157.4*	**

* Estimated annual rate based on first quarter results.

** Not computed.



Source: Table I and II

FIGURE 7 STEEL CONSUMPTION PER THOUSAND DOLLARS OF DURABLE GOODS AND CONSTRUCTION EXPENDITURES

TABLE II

U.S. STEEL PRODUCTION, 1960-2010

Year	Trend Value of Durable Goods and Construction Expenditures (In Billions of 1954 Dollars)	Trend Value of Steel Production (Millions of Short Tons)
1960	132.3	99.3*
1970	206.6	127.3
1980	295.6	149.5
1990	413.8	171.8
2000	578.7	197.2
2010	790.4	221.2

*The 1960 figure is actual steel production. In the projection years, production equals consumption.

Source: Appendix C and Figure 7.

Thus, while U.S. consumption of durable goods and construction activity are expected to increase quite substantially, the amount of steel required for a given product is expected to decline because of the availability of higher-strength steels, better engineering designs, and the substitution of aluminum, plastics, and other materials for steel. The newer, higher-strength steels, for example, are reported to have reduced total U.S. steel consumption by about 10 percent. Some products and uses in which aluminum has partially replaced steel are containers, bridges, highway guard rails, furniture, curtain walls, motor vehicles, and trailers. Glass and plastics have also made competitive inroads into traditional uses of steel.

A projection of U.S. steel output, which is based on projected consumption, must also take into consideration anticipated volumes of imports and exports, not only of crude steel and steel-mill products but also of manufactured goods that contain steel. A separate projection of U.S. foreign trade, however, could not be justified for this project in which the national steel projection serves merely as a general yardstick for the model-derived regional projection. Besides, historical import and export data are poor trend indicators for a long-term projection, because foreign trade volumes have been subject to wide and irregular

fluctuations. Traditionally, the United States has been a net exporter of steel; during the most recent decade, however, net exports failed to reach prewar levels, and beginning in 1959 the United States became a net importer of steel (see Table III). This change can be explained, in part, by the fact that the United States had formerly been able to export considerable quantities of flat-rolled steel products due to the lack of adequate flat-rolling facilities in other parts of the world. The construction of modern facilities in Western Europe and Japan has now cut deeply into this country's traditional overseas markets, and has reversed our net export position.

In the future we believe that the United States will continue as a net importer of steel, but at the same time the country will maintain its position as a net exporter of manufactured products containing steel. (Net exports of manufactured products in recent years contained between 1.8 and 2.9 million tons of steel annually.) Thus, on balance, we expect future imports of steel products to match exports of steel and manufactured goods; we have therefore assumed that future U.S. steel production will approximate steel consumption. This assumption falls well within the margin of error of the basic projection.

It is important to dwell on the fact that the Ohio River Basin projection of ferrous metals production and the national steel output projection are only indirectly related. In terms of the Basin framework, the growth of the regional steel industry hinges primarily on the over-all growth of the regional economy. This should be evident from the manner in which our projection framework and parameters are developed (see Chapter IV) and from the fact that shipments to industries within the region account for almost two-thirds of the total value of the region's shipments of ferrous metals. For projection purposes, moreover, we have assumed that the level of Ohio River Basin shipments of ferrous metals to markets outside of the region will decline in the future, thus reducing the regional steel industry's dependence upon demand originating outside of the Basin. Table IV shows the projected decrease in the relative importance of ferrous metal exports from the Ohio River Basin. Future reductions in export volumes reflect the relative cost disadvantages associated with producing steel in the Basin by comparison with the cost structure of producers outside of the Basin.

When measured against our projection of U.S. steel production, the Basin's future share of the national output is shown to decline from approximately 31 percent in 1960 to 23 percent in 1980; the share is then expected to remain at about the 21 percent level to the end of the projection period (Table V).

TABLE III

DERIVATION OF U.S. DOMESTIC STEEL CONSUMPTION
(Millions of Tons of Crude Steel)

Years	Production	Net Crude Exports (-) or Imports (+)	Net Product Exports (-) or Imports (+)	Domestic Consumption
1929	63,205.5	- 18.0	-2,754.2	60,433.3
1930	45,583.4	+ 5.9	-1,719.6	43,869.7
1931	29,059.0	+ 13.4	- 691.4	28,381.0
1932	15,322.9	+ .9	- 26.4	15,297.4
1933	26,020.2	- 2.4	- 336.1	25,681.7
1934	29,181.9	- 19.5	-1,058.1	28,104.3
1935	38,183.7	- 42.3	- 801.2	37,340.2
1936	53,500.0	- 22.8	-1,022.1	52,455.2
1937	56,636.9	- 376.9	-4,038.4	52,221.6
1938	31,752.0	- 186.9	-2,623.7	28,941.4
1939	52,798.7	- 240.9	-3,008.5	49,549.3
1940	66,982.7	-2,821.9	-7,824.5	56,336.3
1941	82,839.3	-2,310.3	-6,418.9	74,110.1
1942	86,031.9	-2,196.1	-6,757.6	77,078.2
1943	88,836.5	-2,061.2	-6,923.6	79,851.7
1944	89,641.6	-1,107.4	-6,617.6	81,916.6
1945	79,701.6	- 195.6	-6,356.1	73,149.9
1946	66,602.7	- 451.3	-6,012.0	60,139.4
1947	84,894.1	- 489.7	-8,310.7	76,093.7
1948	88,640.5	- 196.0	-5,371.3	83,073.2
1949	77,978.2	- 204.9	-5,837.1	71,936.2
1950	96,836.1	+ 120.8	-1,579.7	95,377.2
1951	105,199.8	+ 7.4	- 145.2	105,062.0
1952	93,168.0	- 669.9	-2,907.3	89,590.8
1953	111,609.7	+ 44.1	-1,328.2	110,325.6
1954	88,311.7	- 20.7	-2,511.3	85,779.7
1955	117,036.1	- 455.8	-3,507.8	113,072.5
1956	115,216.1	- 336.4	-3,840.0	111,039.7
1957	112,715.0	- 502.6	-6,203.2	106,009.2
1958	85,254.9	- 10.1	-1,756.0	83,488.8
1959	93,446.1	+ 77.1	+4,424.4	97,947.6
1960	99,281.6	- 6.7	+ 831.7	100,106.6
1961	98,014.5	+ 41.1	+1,466.8	99,522.4
1962	98,300.0*	***	***	***
1963	109,300.0*	***	***	***
1964	117,000.0**	***	***	***

* Preliminary figures.
** Estimated annual rate based on first quarter results.
*** Not computed.

TABLE IV

FERROUS METAL EXPORTS FROM THE OHIO RIVER BASIN, 1960-2010

Year	Absolute Level of Exports (in 1960 dollars)	Decrease in Volume of Exports	Percent Decrease per Decade	Projected Exports as Percent of Gross Output
1960	3,162.7			37.9
1970	3,004.6	158.1	5	33.6
1980	2,704.1	300.5	10	29.1
1990	2,298.5	405.6	15	23.1
2000	1,838.8	459.7	20	16.4
2010	1,379.1	459.7	25	10.7

TABLE V

OHIO RIVER BASIN STEEL OUTPUT AS A SHARE OF U.S. STEEL OUTPUT, 1960-2010

Year	Basin Output (in millions of 1960 dollars)	Growth Index	Growth Index Applied to 1960 Output* (in millions of short tons)	Basin Output as Percent of U.S. Output
1960	8,348.9	100.0	30.6	30.8
1970	8,930.0	107.0	32.7	25.7
1980	9,307.3	111.5	34.1	22.8
1990	9,967.4	119.4	36.5	21.2
2000	11,245.2	134.7	41.2	20.9
2010	12,837.9	153.8	47.1	21.3

*For 1960, the Ohio River Basin's volume of production was calculated as the sum of the total output in the Pittsburgh-Youngstown region and 1.5% of the total output of the Chicago-St. Louis region.

APPENDIX K-2

COAL MINING

Projections of coal production in the Ohio River Basin were based on estimates of the demand for coal by each of five end-use sectors, as summarized below:

PROJECTED DEMAND FOR OHIO RIVER BASIN COAL
(million short tons)

	1960	1970	1980	1990	2000	2010
End-Use Sector:						
Electric Power	133.9	255.8	478.6	713.0	934.4	1096.4
Coke Ovens, Blast Furnaces	58.6	58.4	58.1	57.3	58.7	62.7
Other Industrial Uses	94.8	99.0	114.0	132.0	153.0	177.0
Domestic and Commercial Use	12.0	5.5	3.5	2.5	2.0	2.0
Export	36.4	45.0	45.6	46.6	47.4	48.6
Synthetic Natural Gas	--	--	--	--	37.3	135.0
Total, Ohio River Basin States	335.7	463.7	699.8	951.4	1232.8	1521.7
Adjusted for 384 Basin Counties	316.7	430.0	665.0	905.0	1170.0	1450.0

The number of tons of coal to be consumed by the electric power sector--by far the largest user--was computed from estimated total electric power generation from coal and the estimated coal requirement per unit of electric energy generation (see Appendix J). The electric energy to be produced from coal was computed from projections of total electric power demand in areas which now rely upon Basin coal by subtracting the likely future contribution of nuclear, hydroelectric, and internal combustion power sources in these areas.

Coal requirements for coke ovens and blast furnaces were determined from steel projections for the nation (see Appendix K-1), using projected ratios of pounds of coke per ton of pig iron as well as coal requirements for direct blast furnace injections. Then the estimated proportion of each steel-producing region's coal requirements to be supplied by the Ohio River Basin was applied to obtain the total demand for Basin coal by the second end-use sector shown in the above tabulation.

We projected energy requirements for other industrial uses as a function of the Federal Reserve Board index of industrial production. Historically, the energy demand for "other industrial uses" has not grown as rapidly as the F.R.B. index because industry has achieved a high level of electrification and continues to increase its efficiency in the use of energy. (These factors have not been offset in the postwar period by any tendency toward increased energy intensity by various new technological processes introduced in the last decade.) Coal's share of this energy market has declined rapidly in recent years due to competition from natural gas and oil. However the decline in coal's share is unlikely to continue at the same rate in the future. We therefore assumed that coal's share of the "other industrial" energy market would stabilize after 1975. The Ohio River Basin's share of coal production for this sector's requirements was assumed to decline slightly to account for the future development of Western and Southern coals.

The domestic and commercial requirements for coal were extrapolated at the steady postwar 10 percent per year rate of decline, dampened to allow for consumption of three million tons annually after the year 2000, of which two million tons would be supplied by the Ohio River Basin.

In the export sector, demand for Ohio River Basin coal in Canada, South America, Japan and Western Europe was estimated individually. For example, we estimated Japan's purchases by considering both the anticipated growth in that nation's steel industry and the likely share of Japanese coal imports which the United States will provide.

In the final end-use sector, synthetic natural gas, it was necessary to project progress in technology in order to obtain figures on future coal consumption. We quantified our analysis of technological change in the production of synthetic natural gas from coal by estimating future price declines in this fuel, so as to determine how soon synthetic natural gas would become competitive with natural gas, which we assumed to experience a continuing rise in price. Our computations indicate that synthetic natural gas would be cheaper than natural gas in the eastern part of the Ohio River Basin after 1990 and in the western part of the Basin after 1996. We then applied the estimated share which synthetic natural gas would have of the natural gas market to our projections of that market's size in order to project the demand for synthetic natural gas. We then found the coal requirements of this end-use sector by applying the industry specialist's estimates of coal needed per unit of synthetic natural gas produced.

Coal demand in each of the above described five end-use sectors was aggreated to yield total Ohio River Basin coal production in future years. we applied an index of the growth in physical output to our 1960 output measured in dollars (See Appendix E-1) in order to obtain a projection of coal output in 1960 dollars.

APPENDIX K-3

INDEPENDENT STATISTICAL PROJECTIONS

A. INTRODUCTION

Output (value added) projections for the five remaining "export" industries differ from those discussed in Appendix K-1 and K-2 in three specific ways: (1) they were determined statistically (i.e., through least-squares regression) rather than on the basis of forecasts incorporating the judgment of industry specialists, (2) a range of projections was obtained for each industry rather than a single value estimate, and (3) projections were made both at the 2-digit and at the 3-digit level, with consistency checks throughout.

We elected to use statistical (i.e., regression or correlation analysis) means rather than judgmental means for two important reasons. First, the industrial composition of each 2-digit industry is so diverse and the product composition so varied (e.g., the product composition of the chemical industry ranges from industrial gases to explosives, and that of the nonelectrical machinery industry ranges from engines and turbines to computing and accounting machines) that long-range projections for each component could not be justified. Second, the heterogeneous product composition of each 2-digit industry makes it mandatory to measure output in constant dollars, so that output can then be related to various aggregate growth measures of the economy, such as the gross national product, the GNP components, the Federal Reserve Board index of industrial production, and others.

In all five industry projections, national value added projections were made first through least-squares regression, by relating 2-digit and 3-digit national output (value added) series in constant 1954 dollars to appropriate explanatory variables such as GNP expenditure components.

Three sets of national value-added projections at the 2-digit level were obtained, two of them derived through least-squares regression equations of the form $Y = a + bX$ and $Y = a + b_1X_1 + b_2X_2$, and the third obtained by summing the separate 3-digit projections for each benchmark year. Thereafter, Ohio River Basin value added in each industry was related to the corresponding national industry through least-squares regression

$$\left[\text{Ohio River Basin} = a + b(\text{U.S.}) \text{ and Ohio River Basin} = a + b_1(\text{U.S.}) + b_2(\text{time})\right].$$

Two sets of regional 2-digit value-added projections were obtained by substituting into these equations the projected U.S. value-added levels obtained by summing the separate 3-digit projections for each benchmark year. A third set of regional value-added projections were derived by first estimating the Ohio River Basin's shares of national 3-digit projections, then applying these shares to the national 3-digit value-added projections to find the regional 3-digit value-added estimates, and then summing the regional 3-digit estimates for each benchmark year.

This method rests upon two premises: (1) that the regional growth of an "export" industry over time is primarily correlated to the national growth of that industry, and (2) that the national growth of the industry is in turn functionally related to the growth of one or several appropriate GNP expenditure components. Two aspects of this approach commend its use. First, it provides industry projections which are consistent with the projected rate of growth of the economy as a whole. Second, it minimizes the personal biases inherent in conjectural or speculative projections without avoiding the informed knowledge and judgment of the industry specialist.

Correlation or regression analysis inherently carries the assumption that past relationships between economic time series tend to continue into the future. While this is admittedly a bold assumption, particularly when the length of the time series used is much shorter than the projection horizon, it does not in any way preclude structural changes in the economic system. It merely postulates the much weaker constraint that future changes bear out past and present trends.

The use of regression analysis for projective purposes poses three basic questions for users of this study: (1) What are the criteria used in the selection of the independent variables; (2) What are the underlying reasons for selecting the form of the regression equation; and (3) How significant are the regression relationships?

The first question relates to the logic with which the independent variables were chosen, whether they are economic time series or simply "time" as used in most "share" extrapolations. In selecting the independent or explanatory variables, we emphasized economic meaningfulness rather than merely the achievement of a high degree of correlation. On the other hand, we used "time" as the independent variable, when this seemed to be the reasonable choice both economically and statistically.*

*The use of "time" as an independent variable reflects the cumulative and continuing effect of a large number of influences that are supposedly associated with variations in the dependent variable.

The second question addresses itself to the choice of the form of the regression equation. This is a critical issue in regression analysis because many equations can be successfully fitted to historical data, each yielding completely different and perhaps untenable projection results. In selecting the form of the equation, therefore, certain outside checks for consistency and reasonableness had to be considered, and the projective characteristics of the equations carefully weighed.*

The third question raises the issue of the degree of significance of a regression relationship for projective purposes. The proper measure of statistical significance depends on the purpose for which the regression relationship is to be used. In economic forecasting, the coefficient of determination (R^2) becomes less important than the standard error of the projection parameters. A high degree of correlation in fact may be an irrelevant criterion of reliability in making long-range projections, particularly when such correlation reflects the in-phase cycle movements of the variables involved. With these factors in mind, we generally applied the following three criteria in deciding upon the "goodness of fit" for projective purposes:

(a) That the causal economic relationship between the dependent variable (value added) and the explanatory variable (e.g., GNP component) be plausible;

(b) That the equation be simple, with a correlation coefficient passing the 10% level significance test; and

(c) That the projections for the target years be judgmentally correct. In other words, reasonable consistency in movement with respect to the growth rates of the explanatory

---

*From a statistical point of view, for example, the logarithmic equation is simple and commends itself in many cases. The more complicated nonlinear forms, such as the parabola or the Gompertz curve, lose an extra degree of freedom and are more difficult to fit. The parabola has the added disadvantage of reversing direction beyond some value of the independent variable. Thus, when "time" is chosen as the independent variable, the resulting regression procedue may be thought of as a convenient means of extrapolating the historical trend line in Y (the dependent variable).

From an economic point of view, the nonlinear logarithmic form is preferable to a linear form whenever long-range projections of a percentage share are sought. In most instances, linear changes in a percentage share are unsustainable over long periods.

variable(s), the 3-digit components, and the separately projected 2-digit industry outputs should be obtained. Moreover, industry output (value added) as a percent of the explanatory variable for the target years should be reasonably consistent with past trends.

The individual industry discussions that follow are organized in such a way as to present the most salient features of the procedure involved in making value-added projections. Each industry discussion is accompanied by a compendium of supplementary tables, which are unique to that industry. A summary of the national and regional value-added projections is provided in Table VI in terms of growth indexes (1960 = 100).*

B. CHEMICALS AND ALLIED PRODUCTS (SIC 28)

1. Summary of Projections

As summarized in Table VII, we expect a continued and significant growth in the chemicals and allied products industry in the nation as well as in the Ohio River Basin. The national output (value added) level is anticipated to increase by about seven times between 1960 and 2010, and the Basin's output is expected to grow at almost the same rate (6.5 to 7.2 times). These projected growth rates are substantially higher than those projected for the Federal Reserve Board index of industrial production (5.84 times) as well as for GNP (5.16 times).

The projections for this industry are in keeping with past trends. Between 1947 and 1960, the nation's value added in chemicals increased by 2.57 times, while the Basin's output increased by 2.47 times. These rates of increase were above the growth rates of the FRB index (1.66 times) and GNP (1.56 times).

2. Nature of the Industry

A comparison of the industry's product composition in the Basin and in the nation reveals that in both cases the order of magnitude of the 3-digit industries relative to the 2-digit value added total is roughly the same. However, SIC's 281 and 282 are more important regionally than nationally, whereas the reverse applies to SIC 283.

*For a detailed treatment of each statistical industry projection, see Working Papers.

TABLE VI

SUMMARY OF VALUE ADDED PROJECTIONS FOR THE UNITED STATES AND THE OHIO RIVER BASIN: COMPARATIVE GROWTH RATES
(1960 = 100)

		1960	1970	1980	1990	2000	2010
Gross National Product		100	142	199	273	381	516
Federal Reserve Board Industrial Production Index		100	147	210	297	426	584
U.S. Value Added Projections:[1]							
SIC 28 - Chemical and Allied Products		100	164	249	361	521	722
SIC 32 - Stone, Clay and Glass Products		100	140	190	258	356	478
SIC 34 - Fabricated Metal Products		100	135	181	248	348	472
SIC 35 - Machinery, Except Electrical		100	165	226	307	424	567
SIC 36 - Electrical Machinery		100	154	231	335	487	676
Ohio River Basin Value Added Projections:[2]							
SIC 28 - Chemical and Allied Products	1.	100	164	248	359	518	717
	2.	100	161	238	337	474	645
	3.	100	160	236	336	478	647
SIC 32 - Stone, Clay and Glass Products	1.	100	133	173	226	303	400
	2.	100	133	177	239	332	451
	3.	100	127	160	204	268	349
SIC 34 - Fabricated Metal Products	1.	100	136	183	249	350	475
	2.	100	212	285	392	553	755
	3.	100	134	178	244	344	468
SIC 35 - Machinery, Except Electrical	1.	100	176	236	315	430	570
	2.	100	162	221	305	437	603
	3.	100	172	229	304	411	541
SIC 36 - Electrical Machinery	1.	100	166	248	359	520	721
	2.	100	163	246	362	533	748
	3.	100	154	228	327	471	652

NOTES: [1]Sum of separate 3-digit value-added projections. For each 2-digit industry, two other sets of value added projections were made. For details, refer to accompanying text.

[2]Three sets of regional value-added projections were made:

1. Projections derived from linear regression equations of the general form $Y = a + bX$, where X represents the sum of U.S. 3-digit value-added projections.
2. Projections derived from linear regression equations of the general form $Y = a + b_1X + b_2t$, where X represents the sum of U.S. 3-digit value-added projections and t represents time, a second explanatory variable.
3. Sum of separate 3-digit regional value-added estimates. For details, refer to accompanying text.

TABLE VII

SUMMARY OF U.S. AND OHIO RIVER BASIN VALUE ADDED PROJECTIONS

Chemical and Allied Products (SIC 28)
(in millions of 1954 dollars)

	1960 (actual)	1970	1980	1990	2000	2010
U.S. Value Added Projections (sum of 3-digit projections)	13,970.5	22,953.1	34,736.4	50,401.9	72,801.1	100,937.1
Index (1960=100)	100	164	249	361	521	722
Ohio River Basin Projections:						
(1) ORB=32.0+0.12707 (U.S.)	1,792.8	2,948.7	4,446.0	6,436.6	9,282.8	12,858.1
Index (1960=100)	100	164	248	359	518	717
(2) ORB=145.50+0.10341 (U.S.) +15.41 (time)	1,792.8	2,888.9	4,261.5	6,035.6	8,506.0	11,569.7
Index (1960=100)	100	161	238	337	474	645
(3) SUM of 3-digit Projections	1,792.8	2,860.7	4,231.7	6,020.4	8,566.1	11,602.4
Index (1960=100)	100	160	236	336	478	647

Note: For details, see accompanying text.
ORB is abbreviation for Ohio River Basin.

SIC	Industry	Percent of 2-Digit Value Added Total, 1958*	
		Ohio River Basin	United States
281	Basic Chemicals	38.43	33.96
282	Fibers, Plastics, Rubbers	20.40	15.41
283	Drugs	12.45	17.53
284	Cleaning and Toilet Goods	16.35	16.05
285	Paints and Varnishes	4.22	5.94
286	Gum and Wood Chemicals	.07	.69
287	Agricultural Chemicals	2.79	3.64
289	Other Chemical Products	5.29	6.78
SIC's 286, 287, 289 combined		8.15	11.11

*Computed in constant 1954 dollars.

3. National Value Added Projections

a. Regression Analysis

The regression equations used in making 3-digit and 2-digit industry value added projections for the United States are presented in Table VIII. Value added series for each industry were plotted against a number of explanatory variables to determine which of these is most closely correlated to the particular industry series. Each industry was then regressed on the finally selected explanatory or independent variable. Two types of equations were fitted: (1) a simple linear regression equation of the form $Y = a + bX$, and (2) a multiple regression equation of the form $Y = a + b_1X_1 + b_2X_2$, where X_2 usually represents "time" as an additional explanatory variable.

In some cases several explanatory variables were tried alternatively until an acceptable fit was achieved. In a few instances where the possibility of a nonlinear relationship appeared, a semi- or double-logarithmic function was tried. In general, however, the best marriage of statistical significance and economic plausibility was obtained from a simple linear relationship.

To derive projections for each decade, projected values of the explanatory variables were substituted into the equations. Thus, two sets of 2-digit value added projections were obtained from the first two equations in Table VIII. The other equations provided projections for the 3-digit industries, which, when summed each decade, provided a third set of national 2-digit value added projections.

The derivation of the historical data used in the regression analyses, as well as the derivation of the projected values of explanatory variables, are explained below in detail.

TABLE VIII

U.S. VALUE ADDED PROJECTIONS, CHEMICALS AND ALLIED PRODUCTS (SIC 28)
REGRESSION EQUATIONS

SIC	Industry Title	Regression Equation*	R^2	Percent Level of Significance** (.01 = 1%)
28	Chemicals and Allied Products	$Y = -5427.00 + 174.71\ X$ (1400.00) (15.78)	.910	Less than .01
		$Y = 2523.000 + 39.230\ X + 502.706(\text{time})$ (28.55) (101.00)	.971	" " "
		where:		
		Y = Value Added, in millions of 1954 dollars		
		X = FRB industrial production index		
		t = time (1947 = 1, . . . , 2010 = 64)		
281	Basic Chemicals	$Y = -1723.700 + 59.964\ X$ (384.7) (4.316)	.941	" " "
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = FRB industrial production index		
282	Plastic Materials and Synthetic Resin	$Y = -913.900 + 73.510\ X$ (211.7) (6.181)	.921	" " "
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = Personal consumption expenditures on durable goods (GNP component) in billions of 1954 dollars		
283	Drugs	$Y = -1413.30 + 261.55\ X$ (120.8) (10.58)	.981	" " "
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = Personal consumption expenditures on medical care		

TABLE VIII (Continued)

SIC	Industry Title	Regression Equation	R^2	Percent Level of Significance** (.01 = 1%)
284	Soaps, Cleaning Detergents, etc.	$Y = -1764.00 + 395.34\ X$ (183.0) (21.98)	.964	Less than .01

where:

Y = Value Added in millions of 1954 dollars
X = Personal consumption expenditures on personal care and cleaning, in billions of 1954 dollars

285	Paints and Varnishes	$Y = 376.300 + 4.174\ X + 14.760(\text{time})$ (4.[illegible]55) (8.12)	.886	" " "

where:

Y = Value Added in millions of 1954 dollars
X = Private and public construction (GNP component) in billions of 1954 dollars
t = time (1947 = 1, . . . , 2010 = 64)

286	Gum and Wood Chemicals	$Y = -1306.400 + 20.087\ X$ (90.0) (0.742)	.984	" " "
287	Agricultural Chemicals (combined)			
289	Miscellaneous Chemicals (combined)			

where:

Y = Combined value added in millions of 1954 dollars
X = Personal consumption expenditures on nondurable goods (GNP component), in billions of 1954 dollars

*Variations in the number of significant digits in the equations arise from the fact that, for purposes of convenience in presentation, value added is expressed in millions of dollars while GNP components are expressed in billions of dollars. In our regression analysis, however, these variables were expressed in different units (i.e., tens or hundreds of millions or billions) in order to minimize errors that might otherwise have been introduced by rounding. Estimated variance of the regression coefficients "a" and "b" is given underneath these coefficients in each equation.

** "Percent level of significance" states the probability that such a correlation would arise, by random sampling, from an uncorrelated population. In other words, a 1% level of significance for R (coefficient of correlation) may be interpreted as meaning that there is only one chance in a hundred of getting a value of R as high as that recorded when in fact the variables have zero correlation.

b. Value Added Data Selection and Adjustment

(1) Basic value added data at 4-digit industry detail were obtained from the 1947, 1954, 1958 Census of Manufactures and from the Annual Survey of Manufactures for the period 1947-1961.*

(2) The 4-digit value added series were then adjusted for standard industrial classification changes that occurred in 1958, by using the adjustment factors given in Supplementary Table 1 (refer to end of this section). This adjustment table was derived from Appendix C of the 1958 Census of Manufactures, and serves as a "bridge" between the pre-1958 industrial classification system and the "new" classification system used since 1958. The objective of the adjustment of all pre-1958 value added series was to develop more homogeneous value added series.

(3) Value added series adjusted for SIC changes were then aggregated into 3-digit series, which in turn were deflated by using appropriate wholesale price indexes selectively developed from U.S. Bureau of Labor Statistics publications of wholesale price indexes (refer to Supplementary Table 2).**

*For some industries, data were available only for 1947-1960.

**Wholesale price indexes published by the U.S. Bureau of Labor Statistics do not directly correspond to 3-digit industry breakdowns given in the Standard Industrial Classification Manual and used in the Census of Manufactures or Annual Survey reports. Therefore, the first task was to match the 3-digit industries to the wholesale price indexes by using the commodity specifications given for each price index code as the bridge. (See BLS, Wholesale Price Indexes 1960 Specifications for Individual Commodities (June 1963) - A Reprint from BLS Bulletin No. 1376). In several instances the same price index provided an acceptable answer. This was due to the fact that some price index codes were large enough, in terms of their commodity specifications, to cover the products of several 3-digit industries. In one or two cases, the products of a 3-digit industry would be scattered over various price index code classifications. In such cases, the price index having a commodity coverage closest to the products of the 3-digit industry in question was picked as the deflator.

The second task involved the derivation of price indexes for one or more year, 1961, for each BLS code used. Since no monthly averages were available for December 1961, the average of the first eleven months was taken as the price index for the entire year.

Third, the price indexes were shifted from a base of 1957-1959 = 100 to a base of 1954=100. This was done by dividing each series through the particular 1954 index. (For a final statement of price indexes used in deflating the value added series, refer to Supplementary Table 2.)

U.S. 2-digit value added series, measured in constant 1954 dollars, were then obtained by summing the 3-digit deflated value added series. Following this, a derived 2-digit price index was found by dividing the 2-digit U.S. value added series (adjusted for SIC changes) by the deflated 2-digit value added series.

c. Explanatory Variables: Data Selection and Adjustment

The 2-digit and 3-digit U.S. value added series measured in constant 1954 dollars constitute the dependent variables. In order to obtain a set of independent or explanatory variables to which the dependent variables could be related through least-squares regression, we experimented with as many independent variables as possible for each 3-digit value added series and for the 2-digit value added series, before making a final selection of a set of explanatory variables.

The explanatory variables were drawn from expenditure components of the gross national product (e.g., personal consumption expenditures on nondurable goods), the FRB index of industrial production, and other variables such as personal consumption expenditures on personal care. The GNP components and the FRB index are discussed in Appendix C. This appendix, therefore, deals only with the derivation of the other explanatory variables, namely personal consumption expenditures on personal care and cleaning and on medical care.

(1) Personal consumption expenditures in current dollars were obtained for both categories (i.e., medical care, personal care and cleaning) from U.S. Income and Output 1958, Table II-4, p. 150 for the years 1947-1955; Survey of Current Business (July 1962), Table 14, p. 14 for the years 1956-1958; and Survey of Current Business (July 1963), Table 14, p. 20 for the years 1958-1960.

(2) These two expenditure series were then deflated by using selectively developed consumer price indexes applied to specific commodities comprising each expenditure category. Consumption expenditures on personal care and cleaning and on medical care were thus expressed in constant 1954 dollars.

(3) Projections of personal consumption expenditures on personal care and cleaning, as well as on medical care, were made by finding the projected percent shares of the individual commodity expenditure items making up these two expenditure groups (from Table VII, Appendix C), adding them up for each decade, and then applying the result to the projected personal consumption expenditures total for the United States.

4. Ohio River Basin Value Added Projections

a. Summary of Methodology and Results

Three sets of value added projections were obtained for the Ohio River Basin at the 2-digit level. The first two were obtained by regressing value added series for the Basin on U.S. value added series, using the value added data for the period 1947-1961. A third set of projections was obtained by estimating the Basin's percent share of each projected U.S. 3-digit value added, multiplying the projected U.S. value added levels by these projected Basin shares, and summing the results for each decade. The procedure is detailed below.

Two sets of 2-digit value added projections for the Ohio River Basin were obtained by substituting U.S. value added projections (sum of 3-digit projections) into the following regression equations:

(a) $$ORB = \underset{(30.0)}{32.000} + \underset{(0.00283)}{0.12707}\ (U.S.) \qquad R^2 = .994$$

(b) $$ORB = \underset{}{145.50} + \underset{(0.01733)}{0.10341}\ (U.S.) + \underset{(11.14)}{15.41}\ (t) \qquad R^2 = .994$$

where:

ORB = Value Added in the Ohio River Basin in millions of 1954 dollars

U.S. = Value added in the United States in millions of 1954 dollars

t = time (1947 = 1, . . . , 2010 = 64)

A third set of value added projections was obtained for the Basin at the 2-digit level by assuming that the Basin's percent share of national value added in each 3-digit industry will change at the same rate as its 2-digit share. For all 3-digit industries, the operational aspect of this assumption can be summarized as follows:

$$\begin{bmatrix} \text{ORB 3-digit value added projections to year n SIC 281} \\ \vdots \\ \text{SIC's 286, 287, 289} \end{bmatrix} = \begin{bmatrix} \text{ORB/U.S. 3-digit \% shares in 1960 SIC 281} \\ \vdots \\ \text{SIC's 286, 287, 289} \end{bmatrix} \times \begin{bmatrix} \dfrac{\text{ORB/U.S. 2-digit percent share in year n}}{\text{ORB/U.S. 2-digit percent share in 1960}} \end{bmatrix} \times \begin{bmatrix} \text{U.S. 3-digit value added projections to year n SIC 281} \\ \vdots \\ \text{SIC's 286, 287, 289} \end{bmatrix}$$

where the Basin/U.S. 2-digit percent share is obtained for each decade by using the Basin value added projections derived through regression equation (a) above (ORB = 32.000 + 0.12707 (U.S.)). The value added projections thus derived are summed for each decade to obtain the 2-digit totals. The results are presented in Table VII.

b. Value Added Data Selection and Adjustment

(1) Value added series at the 2-digit level were developed for the Basin for the period 1947-1961 from the 1947, 1954, and 1958 Census of Manufactures and the Annual Survey of Manufactures series. The following steps were involved: First, we determined the employment level in the Basin part of each state and expressed it as a percent of total state employment in chemicals for the years 1940, 1950, and 1960, using Census of Population data. We then interpolated to find the intervening years. Thereafter, using these percent shares as weights, we allocated the 2-digit value added series for each state to the Basin part of the state. Summing the results for each year provided value added series for the Basin at the 2-digit level. Two critical but inevitable assumptions were involved in this estimation procedure: (a) that the employment share of a sub-state area is the same as that area's value added share, where the "state" is the base, and (b) that changes in the employment share of each sub-state area lying within the Basin were uniform in all the intervening years.

Since the boundaries of the Ohio River Basin are not coterminous with those of the states, and since historical value added data are not available at the county level, the estimation procedure described here is the best available under these circumstances.

(2) After the 2-digit value added series had been developed for the Basin, they were adjusted for changes in standard industrial classification that occurred in 1958. We assumed that the percentage changes experienced by the national 2-digit industry as a consequence of SIC adjustments were also applicable to the Basin's 2-digit industry.

(3) The value added series adjusted for SIC changes were then deflated by the implicit deflators at the 2-digit level derived for the national industry (refer to Supplementary Table 2) in order to express them in constant 1954 dollars.

(4) A reliable set of 3-digit value added data for the Basin was available for 1958 only -- the year for which the Bureau of the Census had prepared a specially commissioned tabulation for the Basin area. We updated these value added totals to 1960, by applying to them the respective percentage growth rates experienced by the Basin states between 1958 and 1960.

SUPPLEMENTARY TABLE 1

ADJUSTMENTS MADE IN PRE-1958 VALUE ADDED SERIES TO ACCOUNT FOR THE 1958 INDUSTRIAL CLASSIFICATION CHANGES

New SIC*	Composed of Old SIC**	Percent of Old in New
281 - 2812	2812	100
2813	2896	100
2814	2821	100
2815	2822	100
2816	2852	98.42
2818	2829	98.63
2819	2819	100
	2811	100
282 - 2821	2823	100
2822	2824	100
2823	2825	46.53
2824	2825	52.50
283 - 2831	2831	100
2833	2832-2833	100
2834	2834	99.45
284 - 2841	2841	99.79
	2842	46.26
2842	2842	50.26
	2899	16.84
2843	2842	2.02
	2843	99.38
	2829	.99
2844	2893	100
285 - 2851	2851	99.86
2852	2853	95.99
	2842	1.27
286 - 2861	2861	100
	2862	100
	2863	100
	2865	100
	2611	5.44***

SUPPLEMENTARY TABLE 1 (Continued)

New SIC *	Composed of Old SIC**	Percent of Old in New
287 - 2871	2871	100
2872	2872	100
2873-2879	2897	92.66
	2899	7.37
289 - 2891	2894	100
	2899	4.93
2892	2826	100
2893	2891	100
2894	2887	100
2895	2895	98.13
2899	2892	100
	2899	64.43
	3985	100
	2898	100

*The 1957 Standard Industrial Classification Manual, as used in the 1958 Census of Manufactures.

**Based on the 1945 and 1949 SIC Manuals, as modified in the 1947 and 1954 Census of Manufactures.

***Corresponds to "tall oil." Adjustments were made by estimating the tall oil output for each year from 1947 to 1957, and by adding it to the SIC 286 value-added figure.

SUPPLEMENTARY TABLE 2

PRICE INDEXES USED TO DEFLATE CHEMICALS AND ALLIED PRODUCTS
(SIC 28) VALUE ADDED SERIES, (1954 = 100.0)

Year	SIC 28 Implicit Price Index	SIC 281	282	283	284	285	286	287	289
1947	91.7	84.1	94.8	112.2	93.7	87.3	94.8	84.0	93.7
1948	--	89.3	97.0	107.6	96.8	88.8	97.0	89.0	96.8
1949	88.0	81.8	88.6	99.7	88.4	89.7	88.6	92.5	88.4
1950	89.1	86.0	89.9	98.5	87.9	88.0	89.9	89.9	87.9
1951	101.4	102.6	102.9	101.9	100.8	96.6	102.9	94.1	100.8
1952	97.5	97.9	97.6	98.5	96.0	97.8	97.6	97.9	96.0
1953	98.7	100.0	98.8	99.0	96.0	98.5	98.8	99.9	96.0
1954	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1955	99.7	100.5	99.6	98.9	98.5	101.5	99.6	99.6	98.5
1956	100.3	103.3	100.2	98.1	96.0	106.3	100.2	95.9	96.0
1957	102.1	105.0	102.3	99.4	98.2	112.0	102.3	94.5	98.2
1958	102.7	105.0	103.2	100.1	99.3	113.7	103.2	95.5	99.3
1959	102.6	105.4	102.8	99.3	99.1	113.7	102.8	94.6	99.1
1960	102.9	105.7	103.0	99.8	99.2	113.9	103.0	97.0	99.2
1961*	101.7	103.7	102.0	97.9	98.1	117.2	102.0	99.0	98.1

NOTES: SIC 28: Derived by dividing the value added series in current dollars (adjusted for SIC changes) by the sum of the deflated 3-digit value added series.
SIC 281: U.S. Bureau of Labor Statistics, Wholesale Price Index, Code 06-1 (March 1962)
SIC 282 and SIC 286: BIS Code 06 (April 1962)
SIC 284 and SIC 289: BIS Code 06-7 (March 1962)
SIC 283: BIS Code 06-3 (March 1962)
SIC 285: BIS Code 06-21 (March 1962)
SIC 287: BIS Code 06-6 (March 1962)

*Average of the first eleven months.

SUPPLEMENTARY TABLE 3

CHEMICAL AND ALLIED PRODUCTS INDUSTRY DEFLATED U.S. VALUE ADDED SERIES
(Millions of 1954 dollars; SIC 28 as % of GNP and 3-digit components as % of SIC 28 total)

Years	28	281	282	283	284	285	287, 289
1947 Value Added	5,641.8	1,934.5	781.9	663.1	928.2	549.0	785.2
	2.00	34.29	13.86	11.75	16.45	9.73	13.92
1949	6,776.2	2,462.5	954.4	1,006.8	1,051.0	495.6	806.0
	2.32	36.34	14.08	14.86	15.51	7.32	11.89
1950	8,104.1	2,985.3	1,340.1	1,151.0	1,165.9	569.3	892.4
	2.59	36.84	16.54	14.20	14.39	7.02	11.01
1951	7,962.4	2,839.4	1,278.3	1,240.1	1,041.2	589.3	973.9
	2.33	35.66	16.05	15.57	13.08	7.40	12.23
1952	8,710.7	3,219.0	1,370.8	1,278.7	1,230.9	609.4	1,001.9
	2.46	36.95	15.74	14.68	14.13	7.00	11.50
1953	9,330.6	3,551.5	1,432.4	1,313.8	1,280.5	664.9	1,087.6
	2.52	38.06	15.35	14.08	13.73	7.13	11.65
1954	9,051.9	3,231.2	1,446.4	1,330.2	1,299.4	655.3	1,089.3
	2.51	35.70	15.98	14.70	14.35	7.24	12.03
1955	10,846.2	3,966.1	1,828.3	1,540.2	1,533.3	726.2	1,252.1
	2.75	36.56	16.86	14.20	14.14	6.69	11.55
1956	11,519.9	4,239.0	1,780.4	1,798.0	1,695.0	712.9	1,294.6
	2.87	36.80	15.45	15.61	14.71	6.19	11.24
1957	11,787.2	4,179.6	1,865.2	1,977.8	1,772.5	686.2	1,305.9
	2.89	35.46	15.82	16.78	15.04	5.82	11.08
1958	11,945.3	4,056.9	1,840.9	2,094.2	1,916.5	709.7	1,327.1
	2.98	33.96	15.41	17.53	16.05	5.94	11.11
1959	13,852.4	4,761.1	2,329.5	2,290.5	2,158.6	805.5	1,507.2
	3.24	34.37	16.82	16.54	15.58	5.81	10.88
1960	13,970.5	4,826.4	2,190.0	2,353.8	2,246.9	796.5	1,556.9
	3.18	34.55	15.68	16.85	16.08	5.70	11.14
1961	14,519.6	5,051.1	2,242.3	2,492.2	2,413.6	778.8	1,541.6
	3.24	34.79	15.44	17.16	16.62	5.36	10.63

SUPPLEMENTARY TABLE 4

U.S. VALUE ADDED PROJECTIONS, CHEMICALS AND ALLIED PRODUCTS (SIC 28)
(millions of 1954 dollars)

SIC	1960 Actual	1970	1980	1990	2000	2010
(1) SIC 28 (Y = -5427.00 + 174.71 X)	13,970.5	22,351.9	34,232.2	50,654.9	74,939.6	104,640.3
(2) SIC 28 (Y = 2523.000 + 39.230 X+502.706t)	13,970.5	20,825.4	28,520.0	37,234.6	47,714.6	59,449.9
(3) SUM of 3-digit projections:	13,970.5	22,953.1	34,736.4	50,401.9	72,801.1	100,937.1
SIC 281	4,826.4	7,810.6	11,888.1	17,524.7	25,859.7	36,113.6
SIC 282	2,190.0	3,504.1	5,452.1	8,017.6	11,663.7	16,280.1
SIC 283	2,352.8	5,047.0	7,950.2	11,271.9	16,659.8	22,858.5
SIC 284	2,246.9	3,217.3	4,640.5	6,933.5	9,384.6	13,258.9
SIC 285	796.4	1,020.6	1,283.0	1,583.0	1,950.5	2,373.2
SIC's 286, 287, 289	1,556.9	2,353.5	3,522.5	5,071.2	7,282.8	10,052.8

SUPPLEMENTARY TABLE 5

OHIO RIVER BASIN VALUE ADDED SERIES, CHEMICALS AND ALLIED PRODUCTS (SIC 28)
(millions of 1954 dollars)

Years	Ohio River Basin SIC 28 Total	Basin as Percent of U.S.	SIC 281	282	283	284	285	286, 287, 289
1947	724.5	12.8	-	-	-	-	-	-
1949	873.6	12.9	-	-	-	-	-	-
1950	1063.3	13.1	-	-	-	-	-	-
1951	1072.2	13.5	-	-	-	-	-	-
1952	1127.2	12.9	-	-	-	-	-	-
1953	1231.0	13.2	-	-	-	-	-	-
1954	1180.7	13.0	-	-	-	-	-	-
1955	1397.7	12.9	-	-	-	-	-	-
1956	1534.6	13.3	-	-	-	-	-	-
1957	1569.6	13.3	-	-	-	-	-	-
1958	1568.7	13.1	573.4	304.4	185.7	244.0	63.0	121.6
	(Percent of U. S. 3-digit)		14.1	16.5	8.9	12.7	8.9	9.0
1959	1732.8	12.5	674.2	375.2	204.7	276.8	68.3	133.6
	(Percent of U.S. 3-digit)		14.2	16.1	8.9	12.8	8.5	8.6
1960	1792.8	12.8	725.2	353.3	213.5	297.5	69.6	133.7
	(Percent of U.S. 3-digit)		15.0	16.1	9.1	13.2	8.7	8.3
1961	1878.7	12.9	764.2	389.9	225.2	312.0	68.8	118.6
	(Percent of U.S. 3-digit)		15.1	17.4	9.0	12.9	8.8	8.1

SUPPLEMENTARY TABLE 6

OHIO RIVER BASIN VALUE ADDED PROJECTIONS, CHEMICALS AND ALLIED PRODUCTS (SIC 28)
(millions of 1954 dollars)

	1960 Actual	1970	1980	1990	2000	2010
(1) Basin = 32.0 + 0.12707 (U.S.)	1,792.8	2,948.7	4,446.0	6,436.6	9,282.8	12,858.1
(2) Basin = 145.50 + 0.10341 (U.S.) + 15.41 (t)	1,792.8	2,888.9	4,261.5	6,035.6	8,506.0	11,569.7
(3) SUM of 3-digit projections:	1,792.8	2,860.7	4,231.7	6,020.4	8,566.1	11,602.4
SIC 281	725.2	1,155.2	1,715.5	2,467.5	3,581.6	4,871.7
SIC 282	353.3	556.5	845.1	1,212.3	1,734.4	2,359.0
SIC 283	213.5	450.7	693.3	958.1	1,392.8	1,863.0
SIC 284	297.5	419.2	590.3	860.4	1,145.9	1,576.5
SIC 285	69.6	87.8	107.8	129.6	157.2	186.3
SIC 286, 287, 289	133.7	191.3	279.7	392.5	554.2	745.9

C. STONE, CLAY AND GLASS PRODUCTS (SIC 32)

1. Summary of Projections

As shown in Table IX, we expect an almost five-fold increase in the output (value added) of the stone, clay and glass products industry in the nation and a 3.5 to 4.5-fold increase in the Ohio River Basin. Our national value added projections at the 3-digit level indicate that glass, pottery and clay products (SIC 321, 322, 323, 325 and 326) will decline in relative importance, while hydraulic cement (SIC 324), concrete, gypsum and plaster products (SIC 327), cut stone and stone products (SIC 328) and abrasives, asbestos and miscellaneous nonmetallic mineral products (SIC 329) will all increase in relative importance. Postwar national trends in the output of these 3-digit industries strongly support the projected trends.

We expect continued growth of the regional industry both because of increasing demand for stone, clay and glass products and because the Basin has ample supplies of the raw materials needed by this resource-oriented industry.

2. Nature of the Industry

A comparison of the industry's regional and national 3-digit value added composition reveals a few important differences in the relative importance of the 3-digit industries. Most important in the Basin is the glass and glassware industry (SIC 322), comprising 32 percent of the Basin's total value added and employment in the 2-digit industry. Nationally, on the other hand, the concrete, gypsum and plaster products industry (SIC 327) is dominant, accounting for nearly 30 percent of national value added as well as employment in the entire 2-digit industry. At the 2-digit level, the Basin in 1958 accounted for almost 23 percent of total national value added in the stone, clay and glass products industry.

SIC	Industry Title	2-Digit Value Added Percent Distribution, 1958	
		Ohio River Basin	United States
32	Stone, clay and glass products	100.00	100.00
321	Flat glass	9.91	5.02
322	Glass and glassware, pressed and blown	31.99	14.19
323	Glass products of purchased glass	3.07	3.83
324	Cement, hydraulic	7.04	12.63
325	Structural clay products	14.05	8.66
326	Pottery and related products	8.08	5.06
327	Concrete, gypsum and plaster products	13.17	29.48
328	Cut stone and stone products	1.75	2.33
329	Abrasives, asbestos and miscellaneous nonmetallic mineral products	10.94	18.80

TABLE IX

SUMMARY OF U. S. AND OHIO RIVER BASIN VALUE ADDED PROJECTIONS

Stone, Clay and Glass Products (SIC 32)*
(in millions of 1954 dollars)

	1960 (actual)	1970	1980	1990	2000	2010
U. S. Value Added Projections (sum of 3-digit projections)	5,317.2	7,428.0	10,113.7	13,707.9	18,914.6	25,406.5
Index (1960=100)	100	140	190	258	356	478
Ohio River Basin Value Added Projections:						
(1) ORB=242.5+0.1536 (U.S.)	1,037.2	1,383.4	1,796.0	2,348.0	3,146.2	4,145.0
Index (1960=100)	100	133	173	226	303	400
(2) ORB=85.4+0.2038 (U.S.) - 9.15 (time)	1,037.2	1,379.6	1,835.5	2,476.5	3,446.1	4,677.7
Index (1960=100)	100	133	177	239	332	451
(3) SUM of 3-digit Projections	1,073.3	1,358.5	1,712.8	2,188.6	2,876.3	3,742.3
Index (1960=100)	100	127	160	204	268	349

*For details, see accompanying text.

3. National Value Added Projections

a. Regression Analysis

The regression equations used in making 3-digit and 2-digit industry value added projections for the United States are presented in Table X. Value added series for each industry were plotted against a number of explanatory variables to determine which of these is most closely correlated to the particular industry series. Each industry was then regressed on the finally selected explanatory or independent variable. Two types of equations were fitted: (1) a simple linear regression equation of the form $Y = a + bX$, and (2) a multiple regression equation of the form $Y = a + b_1X_1 + b_2X_2$, where X_2 usually represents "time" as an additional explanatory variable.

In some cases several explanatory variables were tried alternatively until an acceptable fit was achieved. In a few instances where the possibility of a nonlinear relationship appeared, a semi- or double logarithmic function was tried. But in general the best marriage of statistical significance and economic plausibility was obtained from a simple linear relationship. To derive projections for each decade, projected values of the explanatory variables were substituted into the equations. Thus, two sets of 2-digit value added projections were obtained from the first two equations in Table X. The other equations provided projections for the 3-digit industries, which, when summed each decade, provided a third set of national 2-digit value added projections.

The derivation of the historical data used in the regression analyses, as well as the derivation of the projected values of explanatory variables, are explained below in detail. A summary of national value added projections is given in Supplementary Table 10.

b. Value Added Data Selection and Adjustment

(1) Basic value added data at 4-digit industry detail were obtained from the 1947, 1954, and 1958 Census of Manufactures and from the Annual Survey of Manufactures series for the period 1947-1960.

(2) The 4-digit value added data were then adjusted for changes in the standard industrial classification system that occurred in 1958, by using the adjustment factors given in Supplementary Table 7.

(3) The adjusted value added series, aggregated into 3-digit series, were deflated by using the price indexes given in Supplementary Table 8. An

implicit 2-digit price index was obtained for the United States by dividing the 2-digit undeflated value added series (adjusted for SIC changes) by the sum of the deflated 3-digit value added series.

c. Explanatory Variables: Data Selection and Adjustment

The explanatory variables used in the regression analysis described above are listed for each regression equation in Table X. They can also be found in Appendix C. The deflated 2-digit and 3-digit U. S. value added series were related to these explanatory variables in order to make national projections of value added.

4. Ohio River Basin Value Added Projections

a. Summary of Methodology and Results

Three sets of value added projections were obtained for the Ohio River Basin at the 2-digit level. The first two were obtained by regressing value added series for the Basin on U. S. value added series, using the value added data for the period 1947-1960. A third set of projections was obtained by estimating the Basin's percent share of each projected U. S. 3-digit value added, multiplying the projected U. S. value added levels by these projected Basin shares, and summing the results for each decade. The procedure is detailed below.

Two sets of 2-digit value added projections for the Ohio River Basin were obtained by substituting U. S. value added projections (sum of 3-digit projections) into the following regression equations:

(a) $ORB = 242.5 + 0.1536\ (U.S.)$
$\qquad\qquad (14.1)\ \ (0.0100) \qquad\qquad R^2 = .980$

(b) $ORB = 85.4 + 0.2038\ (U.S.) - 9.15\ (t)$
$\qquad\qquad\quad (0.0173) \qquad\ (3.16) \qquad\qquad R^2 = .971$

where:

ORB = Value added in the Ohio River Basin in millions of 1954 dollars

U.S. = Value added in the United States in millions of 1954 dollars

t = time (1947=1, . . . , 2010=64)

TABLE X

U. S. VALUE ADDED PROJECTIONS, STONE, CLAY AND GLASS PRODUCTS (SIC 32)
REGRESSION EQUATIONS

SIC	Industry Title	Regression Equation*	R^2	Percent Level of Significance (.01 = 1%)**
32	Stone, Clay and Glass Products	$Y = 396.0 + 36.611\ X$ (353.8) (3.066)	.920	.01
		$Y = 1121.3 + .02693\ X + 47.89(\text{time})$ (0.006092) (26.76)	.940	.01
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = Construction and Total Durables (GNP components) in billions of 1954 dollars		
		t = time (1947 = 1, . . . , 2010 = 64)		
321	Flat Glass	$Y = 394.8 + 5.2870\ X$ (195.4) (.9921)	.700	.01
322	Glass and Glassware			
323	Glass Products of Purchased Glass			
326	Pottery and Related Products			
		where:		
		Y = Combined Value Added in millions of 1954 dollars		
		X = Construction, Consumer Durables and Consumer Nondurables (GNP components) in billions of 1954 dollars		
324	Cement, Hydraulic	$Y = -6.0 + 13.171\ X$ (40.0) (1.0)	.940	.01
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = Construction (GNP component) in billions of 1954 dollars		

TABLE X (Continued)

SIC	Industry Title	Regression Equation*	R^2	Percent Level of Significance (.01 = 1%)**
325	Structural Clay Products	Y = 278.0 + 3.954 X (45.8) (1.14)	.480	.05
		where: Y = Value Added in millions of 1954 dollars X = Construction (GNP component) in billions of 1954 dollars		
327	Concrete, Gypsum and Plaster Products	Y = -155.6 + 35.198 X (142.2) (3.523)	.890	.01
		where: Y = Value Added in millions of 1954 dollars X = Construction (GNP component) in billions of 1954 dollars		
328	Cut Stone and Stone Products	Y = 7.6 + 2.830 X (17.4) (0.436)	.770	.01
		where: Y = Value Added in millions of 1954 dollars X = Construction (GNP component) in billions of 1954 dollars		
329	Abrasives, Asbestos and Miscellaneous Nonmetallic mineral Products	Y = 96.2 + 8.466 X (70.0) (0.787)	.910	.01
		where: Y = Value Added in millions of 1954 dollars X = FRB index of industrial production		

(Continued)

TABLE X (Continued)

Footnotes to table.

*Variations in the number of significant digits in the equations arise from the fact that, for purposes of convenience in presentation, value added is expressed in millions of dollars while GNP components are expressed in billions of dollars. In our regression analysis, however, these variables were expressed in different units (i.e., tens or hundreds of millions or billions) in order to minimize errors that might otherwise have been introduced by rounding. Estimated variance of the regression coefficients "a" and "b" is given underneath these coefficients in each equation.

**"Percent level of significance" states the probability that such a correlation would arise, by random sampling, from an uncorrelated population. In other words, a 1% level of significance for R (coefficient of correlation) may be interpreted as meaning that there is only one chance in a hundred of getting a value of R as high as that recorded when in fact the variables have zero correlation.

A third set of value added projections was obtained for the Basin at the 2-digit level by assuming that the Basin's percent share of national value added in each 3-digit industry (computed for 1958) will change at the same rate as the Basin's 2-digit share. For all 3-digit industries the operational aspect of this assumption can be summarized as follows:

$$\left[\begin{array}{c}\text{ORB 3-digit value added in year n (1970, ..., 2010)}\end{array}\right] = \left[\begin{array}{c}\text{ORB percent share of U. S. 3-digit value added in 1960}\end{array}\right] \times \left[\begin{array}{c}\dfrac{\text{ORB \% share of U. S. 2-digit value added in year n}}{\text{ORB \% share of U. S. 2-digit value added in 1960}}\end{array}\right] \times \left[\begin{array}{c}\text{U. S. 3-digit value added projections}\end{array}\right]$$

where the Basin/U. S. 2-digit percent share is obtained for each decade by using the Basin value added projections derived through regression equation (a) given in the preceding paragraph (i.e., ORB = 242.5 + 0.1536 (U. S.)). The value added projections thus derived for each 3-digit industry were summed for each decade in order to obtain 2-digit Basin totals. The results are presented in Table IX.

b. Value Added Data Selection and Adjustment

The lack of 2-digit or 3-digit value added series for the Ohio River Basin necessitated the implementation of a somewhat circuitous methodology. Value added data for the Basin were only available for 1958, for which year a special tabulation of the Census of Manufactures had been prepared by the Bureau of the Census. In summary, the approach consisted of the following steps: First, we computed for 1958 the percentage relationship between the Basin's value added total at the 2-digit level and the combined 2-digit value added total for the seven states of which major portions lie within the geographical boundaries of the Basin. Second, we assumed that this relationship held for each year between 1947 and 1957. Thus, we developed 2-digit value added data for each state for the years 1947-1957, adjusted them for SIC changes so as to make them comparable with the seven-state total in 1958, and then applied the 1958 relationship of the Basin to the seven-state adjusted total in each year to obtain an estimate of the Basin 2-digit value added total.

Value added series at the 2-digit level were then deflated by using 2-digit regional price indexes derived by weighting national 3-digit price indexes by the relative importance of the regional 3-digit industries in 1958 (see Supplementary Table 8).

The deflated value added series were then related to national 2-digit value added series through least squares regression, as described earlier, in order to obtain two sets of 2-digit value added projections for the Basin.

SUPPLEMENTARY TABLE 7

ADJUSTMENTS MADE ON PRE-1958 VALUE ADDED SERIES TO ACCOUNT FOR 1958 INDUSTRIAL CLASSIFICATION CHANGES IN SIC 32

New SIC		Old SIC	% of Old in New
321	3211	3211	100.00
322	3221	3221	99.11
	3229	3229	100.00
323	3231	3231	100.00
324	3241	3241	99.96
325	3251	3251	98.89
	3253	3253	100.00
		3259	14.40
	3255	3255	100.00
	3259	3254	100.00
		3259	85.58
326	3261	3261	100.00
	3262	3262	100.00
	3263	3263	100.00
	3264	3264	100.00
	3269	3265	100.00
		3269	100.00
327	3271	3271	32.53
	3272	3272	66.71
	3273	*	*
	3274	3274	99.31
	3275	3272	100.00
328	3281	3281	100.00
329	3291	3291	99.88
	3292	3292	100.00
	3293	3293	100.00
	3295	3295	100.00
	3296	3275	100.00
		3299	16.45
	3297	3297	91.88
	3299	3299	83.54
		3298	100.00

*NOTE: Since 3273 was formerly classifie under Wholesale Trade, for which no data on value added are availat , it was estimated from its 1958 percent share of industry 32 excluding 3273.

SOURCE: Bureau of the Census, 1958 Census of Manufactures.

SUPPLEMENTARY TABLE 8

PRICE INDEXES USED TO DEFLATE VALUE ADDED SERIES, STONE, CLAY AND GLASS PRODUCTS (SIC 32)*
(1954=100.0)

	Industries by SIC Code										
Year	321	322	323	324	325	326	327	328	329	32 Excluding 328	32 Including 328
1947	76.3	66.8	74.3	72.2	70.1	77.6	80.4	73.8	73.1	73.8	73.8
1949	84.3	82.5	85.7	83.6	79.0	86.1	87.0	84.3	84.6	84.3	84.3
1950	86.3	83.7	87.8	85.4	84.5	86.4	89.2	86.7	87.6	86.7	86.7
1951	91.6	89.5	93.7	92.1	91.2	92.0	95.8	92.4	91.0	92.4	92.4
1952	91.8	90.7	93.7	92.1	91.6	93.0	96.0	93.1	92.3	93.1	93.1
1953	97.1	96.5	98.1	96.6	96.1	96.2	98.3	97.1	96.8	97.1	97.1
1954	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1955	102.8	104.5	108.6	103.9	105.2	100.2	101.0	102.8	101.6	102.8	102.8
1956	107.2	110.3	115.4	110.4	111.1	108.2	104.7	107.6	104.6	107.6	107.6
1957	109.0	116.1	121.0	116.1	115.7	112.1	107.4	111.6	108.8	111.6	111.6
1958	108.8	123.6	131.6	119.1	117.6	116.5	109.0	114.8	110.6	114.8	114.8
1959	108.7	124.1	131.6	120.3	120.3	118.2	110.6	116.2	112.1	116.2	116.2
1960	106.5	124.0	136.1	122.6	121.4	120.4	118.4	119.5	115.3	119.5	119.5

*U. S. Bureau of Labor Statistics wholesale price indexes were used to deflate the 3-digit value added series. The specific price indexes used for each 3-digit industry are listed below.

SIC Industry		BLS Commodity Code	
321	Flat Glass	131	Flat Glass
322	Glassware, pressed or blown	1262[1] 1263[1]	Household glassware Glass containers
323	Glass products made of purchased glass	1262	Household glassware
324	Cement, hydraulic	1322	Cement
325	Structural clay products	134	Structural clay products
326	Pottery and related products	1261	Dinnerware
327	Concrete, gypsum, and plaster products	133[2] 135[2] 1371[2]	Concrete products Gypsum products Building lime
328	Cut stone and stone products	3/	
329	Abrasives, asbestos and miscellaneous nonmetallic mineral products	1372[4] 1373[4]	Insulation Asbestos cement shingles

1. SIC 322 has two subdivisions, glass containers (3221) and pressed and blown glassware not elsewhere classified (3229). We used the corresponding BLS index 1263, glass containers, for SIC 3221. For SIC 3229 we used BLS household glassware. We weighted the two BLS indexes by the present share of the 4-digit SIC industries in the 3-digit SIC industry in order to get a composite index for SIC 322.

2. SIC 327 has five subdivisions, 3271 concrete brick and block, 3272 concrete products except block and brick, 3273 ready mixed concrete, 3274 lime and 3275 gypsum products, each of which has a corresponding BLS index. We used BLS 133, concrete products, for the sum of SIC 3271, 3272 and 3273 since BLS 133 consists of three components which correspond exactly to the three SIC groups. For SIC 3274 lime we used BLS 1371, building lime, and for SIC 3275, gypsum products, we used BLS 135, gypsum products. Comparison of the unadjusted 3-digit total with the adjusted total gave us the composite index for SIC 327.

3. There is no BLS index corresponding to SIC 328; therefore, after adjusting all the other SIC 3-digit industries, we compared their unadjusted total to the adjusted total to get a price index for SIC 32 excluding 328 which we then used for SIC 328.

4. SIC 329 has seven subdivisions only two of which have corresponding BLS commodity classifications. To get a composite index for 329 we applied BLS 1373, asbestos cement shingles, to SIC 3292, asbestos products, and BLS 1372, insulation materials, to SIC 3296, mineral wool, and then compared the unadjusted total to the adjusted total of the two 4-digit SIC categories.

SUPPLEMENTARY TABLE 9

U. S. VALUE ADDED SERIES, STONE, CLAY AND GLASS PRODUCTS (SIC 32)
(millions of 1954 dollars)

Year	Industries by SIC Code						
	32	321, 322 323, 326	324	325	327	328	329
1947	3,535.0	1,304.0	343.3	398.2	780.0	62.2	647.2
1949	3,316.3	1,103.6	361.8	352.2	825.3	79.6	593.8
1950	4,136.1	1,361.1	457.9	436.9	1,058.4	81.6	740.2
1951	4,350.8	1,382.8	463.7	437.2	1,125.4	80.6	861.1
1952	4,317.9	1,361.4	483.9	418.7	1,140.8	96.2	816.8
1953	4,385.2	1,382.1	480.6	416.5	1,136.8	107.9	861.3
1954	4,386.3	1,373.8	525.5	425.6	1,174.7	121.5	765.1
1955	5,114.9	1,576.1	575.3	494.8	1,404.7	134.0	930.0
1956	5,304.0	1,568.6	608.8	497.3	1,567.5	131.2	930.6
1957	5,055.3	1,511.3	558.3	436.6	1,500.7	125.6	922.8
1958	4,817.8	1,353.5	608.5	417.0	1,420.6	112.4	905.7
1959	5,425.2	1,675.7	664.9	473.4	1,567.6	113.3	930.4
1960	5,317.3	1,621.8	604.3	454.4	1,477.3	119.4	1,039.9

SUPPLEMENTARY TABLE 10

U. S. VALUE ADDED PROJECTIONS, STONE, CLAY AND GLASS PRODUCTS (SIC 32)
(millions of 1954 dollars)

SIC Regression Equations*		1960 Actual	1970	1980	1990	2000	2010
1) SIC 32: $Y_1 = 396.0 + 36.611\ X$		5,317.3	7,959.8	11,218.2	15,545.6	21,582.8	29,333.3
2) SIC 32: $Y_2 = 1121.3 + 0.02693\ X + 47.89\ t$		5,317.3	7,834.4	10,710.1	14,372.1	19,301.8	25,471.8
3) Sum of 3-digit projections (below)		5,317.2	7,428.0	10,113.7	13,707.9	18,914.6	24,406.6
SIC - 321, 322, 323, 326	$Y = 394.8 + 5.2870\ X$	1,621.8	2,043.3	2,636.5	3,421.6	4,544.6	5,954.1
324	$Y = -6.0 + 13.171\ X$	604.3	909.8	1,272.2	1,753.1	2,447.6	3,315.9
325	$Y = 278.0 + 3.954\ X$	454.5	552.8	661.5	805.9	1,014.2	1,274.8
327	$Y = -155.6 + 35.198\ X$	1,477.3	2,290.7	3,258.6	4,543.3	6,398.3	8,717.8
328	$Y = 7.6 + 2.830\ X$	119.4	189.1	266.9	370.2	519.3	705.8
329	$Y = 96.2 + 8.466\ X$	1,039.9	1,442.3	2,018.0	2,813.8	3,990.6	5,438.2

*For an explanation of the regression equations, refer to Table X.

SUPPLEMENTARY TABLE 11

OHIO RIVER BASIN VALUE ADDED SERIES

Stone, Clay and Glass Products (SIC 32)

Year	Value Added (in millions of 1954 dollars)	As Percent of U. S. 2-Digit Value Added
1947	819.3	23.18
1949	737.4	22.24
1950	860.4	20.80
1951	934.6	21.48
1952	901.9	20.89
1953	920.9	21.00
1954	898.5	20.48
1955	1,034.5	20.22
1956	1,070.9	20.19
1957	1,035.9	20.49
1958	939.5	19.50
1959	1,095.3	20.19
1960	1,037.2	19.51

D. FABRICATED METAL PRODUCTS (SIC 34)

1. Summary of Projections

As shown in Table XI, we expect a 4.8-fold increase in the output (value added) of the fabricated metal products industry in the nation between 1960 and 2010. During the same period, the projected growth in the Ohio River Basin will range between a 4.7-fold and a 5.4-fold increase. Two of the three sets of projections for the Basin are very close to the projected national growth rates, indicating a sustained growth in the Basin paralleling that of the industry nationally. This is in keeping with past trends; as indicated in Supplementary Table 16, the fabricated metals industry has been growing at the same rate in the Basin as in the United States. This is reflected by the fact that the Basin's share of total national value added during the postwar period has remained nearly constant at 14 to 15 percent.

2. Nature of the Industry

Like many of the manufacturing industries, the fabricated metals industry is an amalgam of diverse products classified as an "industry" because they share a common form of processing. The considerable product diversity of this industry can be seen in the following breakdown of its 3-digit components:

SIC	Industry Title	Percent Distribution of 2-digit Value Added Total, 1958	
		ORB	U.S.
341	Metal containers	3.70	7.1
342	Cutlery, hand tools, hardware	10.91	12.8
343	Plumbing & nonelectric heating	11.40	7.1
344	Structural metal products	33.12	31.5
345	Screw machine products & bolts	3.64	8.0
346	Metal stampings	12.68	11.1
347	Metal services, n.e.c.	1.96	3.9
348	Fabricated wire products, n.e.c.	2.69	4.7
349	Fabricated metal products, n.e.c.	19.89	13.8
		100.0	100.0

TABLE XI

SUMMARY OF U.S. AND OHIO RIVER BASIN VALUE ADDED PROJECTIONS, FABRICATED METAL PRODUCTS (SIC 34)*
(millions of 1954 dollars)

	1960 Actual	1970	1980	1990	2000	2010
U.S. Value Added Projections: (sum of 3-digit projections)	8,980.8	12,141.5	16,281.4	22,246.3	31,214.8	42,408.0
Index (1960 = 100)	100	135	181	248	348	472
Ohio River Basin Value Added:						
(1) ORB = 18.8 + 0.1419 (U.S.)	1,266.8	1,741.7	2,329.1	3,175.5	4,448.2	6,036.5
Index (1960 = 100)	100	137	184	251	351	477
(2) ORB = -362.3 + 0.2329 (U.S.) - 42.25 (t)	1,266.8	1,451.5	1,993.1	2,959.9	4,626.1	6,810.5
Index (1960 = 100)	100	115	157	234	365	538
(3) SUM of 3-digit projections	1,266.8	1,690.9	2,258.7	3,094.1	4,352.9	5,926.2
Index (1960 = 100)	100	134	178	244	344	468

*For details, see accompanying text.

For purposes of projecting future output, the fact that the industry's components are characterized by a similarity in processing is of little or no significance. Future output depends on future demand, and future demand must be estimated for such diverse products as beer cans, plumbing fixtures, and structural steel. Disaggregating the 2-digit industry into its 3-digit components and projecting these components separately has the following advantages:

(1) Each 3-digit component can be correlated to more appropriate, less generalized independent variables. The demand for metal cans need not be considered in the same equation as the one defining the demand for plumbing fixtures.

(2) The allocation to the Basin can be done independently for each 3-digit component, thus incorporating the extent to which the regional composition of the industry differs from the U.S. composition and the extent to which that difference in composition is changing over time.

On the other hand, the stability in trend which characterizes many economic aggregates composed of heterogeneous components might be sacrificed for a set of less stable component relationships as a result of disaggregation. It is difficult to anticipate which of these considerations is more important for a given industry. For this reason three separate projections of the output of the fabricated metals industry at the 2-digit level are presented here. Two are derived from the aggregated (2-digit) classification; while the third is derived from the disaggregated (3-digit) classifications, each of which is independently projected and then summed to a 2-digit total.

3. National Value Added Projections

a. Regression Analysis

The regression equations used in making 3-digit and 2-digit industry value added projections for the United States are presented in Table XII. Value added series for each industry were plotted against a number of explanatory variables to determine which of these is most closely correlated to the particular industry series. Each industry was then regressed on the finally selected explanatory or independent variable. Two types of equations were fitted: (1) a simple linear regression equation of the form $Y = a + bX$, and (2) a multiple regression equation of the form $Y = a + b_1X_1 + b_2 X_2$, where X_2 usually represents "time" as an additional explanatory variable.

TABLE XII

U.S. VALUE ADDED PROJECTIONS, FABRICATED METAL PRODUCTS (SIC 34), REGRESSION EQUATIONS

SIC	Industry Title	Regression Equations*	R^2	Percent Level of Significance** (.01 = 1%)
34	Fabricated Metal Products Total	$Y = 3376.0 + 57.10X$ (1430.0) (9.43)	.870	.01
		$Y = -752.0 + 127.44X - 261.0\,(t)$ (23.6) (83.1)	.920	.01

where:

Y = Value Added, in millions of 1954 dollars

X = FRB industrial production index

t = time (1947 = 1, ..., 2010 = 64)

341	Metal Cans	$Y = 1399 + 829.6X + 197.1 \log t$ (347.0) (48.0)	.970	.01

where:

Y = Value Added in millions of 1954 dollars

X = Personal Consumption Expenditures on Nondurable Goods

t = time (1947 = 1, ..., 2010 = 64)

TABLE XII (Continued)

SIC	Industry Title	Regression Equations*	R^2	Percent Level of Significance** (.01 = 1%)
342	Cutlery, Hand Tools, Hardware	$Y = 285.6 + 6.6076\ X$ (1511.0) (1.907)	.680	.01
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = Personal Consumption Expenditures on Nondurable Goods		
343	Heating & Plumbing Equipment	Y = % approximation. (No significant correlation with independent variables could be found)	--	--
344	Structural Metal Products	$Y = 721. + 41.77\ X$ (370.0) (8.00)	.830	.01
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = Construction Expenditures		
345	Screw Machine Products	$Y = 165.2 + 6.447\ X$ (173.0) (1.94)	.680	.01
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = FRB index of industrial production		

TABLE XII (Continued)

SIC	Industry Title	Regression Equations*	R^2	Percent Level of Significance** (.01 = 1 %)
346	Metal Stampings	$Y = 80.2 + 13.812\ X - 37.43\ t$ (4.25) (15.0)	.740	.01
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = FRB index of industrial production		
		t = time (1947 = 1, ..., 2010 = 64)		
347	Coating, Engraving, etc.	$Y = -101.7 + 4.626\ X$ (48.0) (.54)	.930	.01
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = FRB index of industrial production		
348	Fabricated Wire Products	$Y = -98.1 + 7.772\ X - 19.83\ t$ (1.61) (5.70)	.860	.01
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = FRB index of industrial production		
		t = time (1947 = 1, ..., 2010 = 64)		

TABLE XII (Continued)

SIC	Industry Title	Regression Equations*	R^2	Percent Level of Significance** (.01 = 1%)
349	Miscellaneous Fabricated Products	$Y = 146.6 + 10.908X$ (55.0) (1.21)	.930	.01

where:

Y = Value Added in millions of 1954 dollars

X = FRB index of industrial production

*Variations in the number of significant digits in the equations arise from the fact that, for purposes of convenience in presentation, value added is expressed in millions of dollars while GNP components are expressed in billions of dollars. In our regression analysis, however, these variables were expressed in different units (i.e., tens or hundreds of millions or billions) in order to minimize errors that might otherwise have been introduced by rounding. Estimated variance of the regression coefficients "a" and "b" is given underneath these coefficients in each equation.

**"Percent level of significance" states the probability that such a correlation would arise, by random sampling, from an uncorrelated population. In other words, a 1% level of significance for R (coefficient of correlation) may be interpreted as meaning that there is only once chance in a hundred of getting a value of R as high as that recorded when in fact the variables have zero correlation.

In some cases several explanatory variables were tried alternatively until an acceptable fit was achieved. In a few instances where the possibility of a nonlinear relationship appeared, a semi- or double-logarithmic function was tried. But in general the best marriage of statistical significance and economic plausibility was obtained from a simple linear relationship. To derive projections for each decade, projected values of the explanatory variables were substituted into the equations. Thus, two sets of 2-digit value added projections were obtained from the first two equations in Table XII. The other equations provided projections for the 3-digit industries, which, when summed each decade, provided a third set of national 2-digit value added projections.

The derivation of the historical data used in the regression analyses, as well as the derivation of the projected values of explanatory variables are explained below in detail.

b. Value Added Data Selection and Adjustment

(1) Basic value added data at 4-digit industry detail were obtained from the 1947, 1954, and 1958 Census of Manufactures and the Annual Survey of Manufactures series for the period 1947-1960. No data were available for 1948.

(2) The 4-digit value added data were then adjusted for changes in the standard industrial classification system that occurred in 1958, by using the adjustment factors presented in Supplementary Table 12. Computed from the data given in Appendix C of the 1958 Census of Manufactures, this adjustment schedule is applied to all pre-1958 years so as to make them conform to the post-1958 data which are given in terms of the new SIC code.

(3) The adjusted 4-digit value added data were then aggregated into 3-digit series which were then deflated in order to isolate real rather than price variations in output. For this purpose a price index for the fabricated metal products industry was derived, as shown in Supplementary Table 13.

c. Explanatory Variables: Data Selection and Adjustment

The explanatory variables used in the regression analysis described above are listed for each regression equation in Table XII. They can also be found in Appendix C. The deflated 2-digit and 3-digit U.S. value added series were related to these explanatory variables in order to make national projections of value added. The 2-digit projection based upon the independent projections of 3-digit components was selected as the best forecast of the industry's national growth. As such it became the base from which the Basin's share of the industry was derived. A summary of national value added projections is provided in Supplementary Table 15.

4. Ohio River Basin Value Added Projections

a. Summary of Methodology and Results

Three sets of value added projections were obtained for the Ohio River Basin at the 2-digit level. The first two were obtained by regressing value added series for the Basin on U.S. value added series, using the value added data for the period 1947-1960. A third set of projections was obtained by estimating the Basin's percent share of each projected U.S. 3-digit value added, multiplying the projected U.S. value added levels by these projected Basin shares, and summing the results for each decade. The procedure is detailed below.

Two sets of 2-digit value added projections for the Ohio River Basin were obtained by substituting U.S. value added projections (sum of 3-digit projections) into the following regression equations:

(a) $ORB = 18.8 + 0.1419\ (U.S.)$
$\quad\quad\quad\quad (157.1) \quad (0.0157)$ $\quad\quad R^2 = .779$

(b) $ORB = -362.3 + 0.2329\ (U.S.) - 42.25\ (t)$
$\quad\quad\quad\quad\quad\quad (0.0806) \quad\quad (36.36)$ $\quad\quad R^2 = .643$

where:

ORB = Value added in the Ohio River Basin in millions of 1954 dollars

U.S. = Value added in the United States in millions of 1954 dollars

t = time (1947 = 1, . . . , 2010 = 64)

A third set of value added projections was obtained for the Basin at the 2-digit level by assuming that the Basin's percent share of national value added in each 3-digit industry will change at the same rate as its 2-digit share. For all 3-digit industries, the operational aspect of this assumption can be summarized as follows:

$$\left[\begin{array}{c}\text{ORB 3-digit value added in year n (1970, ..., 2010)}\end{array}\right] = \left[\begin{array}{c}\text{ORB percent share of U.S. 3-digit value added in 1960}\end{array}\right] \times \left[\begin{array}{c}\dfrac{\text{ORB \% share of U.S. 2-digit value added in year n}}{\text{ORB \% share of U.S. 2-digit value added in 1960}}\end{array}\right] \times \left[\begin{array}{c}\text{U.S. 3-digit value added projection}\end{array}\right]$$

where the Basin/U.S. 2-digit percent share is obtained for each decade by using the Basin value added projections derived through regression equation (a) given in the preceding paragraph (i.e., ORB = 18.8 + 0.1419 (U.S.)).

The value added projections thus derived for each 3-digit industry were summed for each decade in order to obtain 2-digit Basin totals. The results are presented in Table XI.

(b) Value Added Data Selection and Adjustment

(1) Value added series at the 2-digit level were developed for the Basin for the period 1947-1961 from the 1947, 1954, and 1958 Census of Manufactures volumes and the Annual Survey of Manufactures series. This involved the following steps. First we determined the employment level in the Basin part of each state and expressed it as a percent of total state employment in the fabricated metals industry for the years 1940, 1950, and 1960, using Census of Population data. We then interpolated to find the intervening years. Then, using these percent shares as weights, we allocated the 2-digit value added series for each state into the Basin part of the state. Summing the results for each year provided value added series for the Basin at the 2-digit level. Two important but inevitable assumptions were involved in this estimation procedure: (1) that the employment share of a sub-state area is the same as that area's value added share, where the State is the base, and (2) that changes in the employment share of each sub-state area lying within the Basin took place at a uniform rate in all the intervening years.

Since the boundaries of the Ohio River Basin are not coterminous with those of the states, and since historical value added data are not available at the county level, the estimation procedure described above was considered to be the best possible under the circumstances.

(2) After the 2-digit value added series had been developed for the Basin, they were adjusted for changes in standard industrial classification that occurred in 1958. We assumed that the percentage changes experienced by the national 2-digit industry as a consequence of adjustments for SIC changes were also applicable to the Basin's industry.

(3) The value added series adjusted for SIC changes were then deflated by the implicit deflators at the 2-digit level derived for the national industry (see Supplementary Table 12) in order to express them in constant 1954 dollars.

(4) A reliable set of 3-digit value added data for the Basin was available only for 1958, the year for which the Bureau of the Census had prepared a special tabulation of the Census of Manufactures for the Basin area. We updated these value added totals to 1960, by applying to them the respective percentage growth rates experienced by the Basin states between 1958 and 1960.

SUPPLEMENTARY TABLE 12

ADJUSTMENTS MADE IN PRE-1958 VALUE ADDED SERIES TO ACCOUNT FOR THE 1958 INDUSTRIAL CLASSIFICATION CHANGES (SIC 34)

SIC	ADD	DEDUCT
341	-	-
342	-	-
343	3568	-
344	2561 3569	-
345[1]	3494 3495	
346		3465 3466 3467 3468
347	3465 3466 3467 3468	3471
348		3481
349	3591 3592	3494 3495

1. 345 not defined prior to 1957 SIC revision.

Source: U.S. Bureau of the Census, 1958 Census of Manufactures, Appendix C.

SUPPLEMENTARY TABLE 13

DERIVED PRICE INDEX FOR THE FABRICATED METAL PRODUCTS INDUSTRY (SIC 34)

Year	A. FRB Index of Industrial Production: Fabricated Metals Component[1] (1954 = 100)	B. Dept. of Commerce Index of Sales: Fabricated Metals Component[2] (1954 = 100)	C. Derived Price Index[3] (B ÷ A) (1954 = 100)
1947	84.3	67.3	79.8
1948	85.4	69.3	81.1
1949	77.5	62.2	80.3
1950	94.4	79.6	84.3
1951	101.1	92.8	91.8
1952	98.9	92.6	93.6
1953	111.2	103.3	92.9
1954	100.0	100.0	100.0
1955	109.0	110.6	101.5
1956	109.0	120.2	110.3
1957	112.4	125.4	111.6
1958	103.4	117.5	113.7
1959	116.9	136.8	117.0
1960	119.1	136.2	114.4

Notes:

1. From the U.S. Department of Commerce, Business Statistics, 1961 Edition, p.14. Converted from 1957 = 100 to 1954 = 100.

2. Ibid., p. 21. Converted from 1957 = 100 to 1954 = 100; entry for 1947 estimated.

3. The comparability of this derived price index for fabricated metals with the U.S. Department of Labor Commodity Wholesale Price Indexes is quite satisfactory:

(1954 = 100 in each case)	1947	1960
Derived Price Index (shown above)	79.8	114.4
Durable Goods	75.2	118.2
Metals and Metal Products	71.3	120.2
Heating Equipment	83.4	104.5
Plumbing Equipment	80.0	111.5

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SUPPLEMENTARY TABLE 14

U.S. VALUE ADDED SERIES, FABRICATED METAL PRODUCTS (SIC 34)
(millions of 1954 dollars)

3-digit components as percent of total SIC 34

Years	SIC 34	341	342	343	344	345	346	347	348	349
1947										
Value Added	6,698.2	290.1	913.8	1,021.3	1,687.9	539.1	866.2	219.7	334.5	825.6
% of Total	100.0	4.3	13.6	15.3	25.2	8.1	12.9	3.3	5.0	12.3
1949	6,502.3	342.9	898.8	783.2	1,828.5	460.9	818.2	212.4	341.2	816.1
	100.0	5.3	13.8	12.0	28.1	7.1	12.6	3.3	5.2	12.6
1950	7,916.0	405.9	1,090.6	1,063.8	2,085.8	642.7	1,039.1	219.8	441.4	908.3
	100.0	5.1	13.8	13.5	26.4	8.1	13.1	2.8	5.6	11.5
1951	8,452.5	427.1	1,072.0	953.9	2,229.4	857.3	1,078.3	273.7	453.5	1,107.2
	100.0	5.1	12.7	11.3	26.4	10.1	12.7	3.2	5.4	13.1
1952	8,339.0	453.9	1,007.7	895.6	2,367.5	823.0	1,045.5	249.6	428.9	1,067.4
	100.0	5.4	12.1	10.7	28.4	9.9	12.5	3.0	5.1	12.8
1953	9,381.6	505.7	1,153.3	930.7	2,538.5	897.8	1,349.1	356.5	484.7	1,165.2
	100.0	5.4	12.3	9.9	27.0	9.6	14.4	3.8	5.2	12.4
1954	8,231.3	500.4	1,040.7	836.9	2,445.7	665.1	958.1	284.8	413.3	1,086.4
	100.0	6.1	12.6	10.2	29.7	8.1	11.6	3.5	5.0	13.2
1955	9,226.3	562.1	1,260.8	937.6	2,423.5	823.1	1,087.8	319.5	476.9	1,230.0
	100.0	6.1	13.7	10.2	26.3	8.9	11.8	3.5	5.2	13.3
1956	9,111.8	572.1	1,148.6	796.9	2,694.7	767.3	1,000.6	315.8	458.5	1,288.8
	100.0	6.3	12.6	8.8	29.6	8.4	11.0	3.5	5.0	14.2
1957	9,323.8	580.5	1,119.8	711.8	3,001.4	790.0	974.8	385.2	451.3	1,309.0
	100.0	6.2	12.0	7.6	32.2	8.5	10.5	4.1	4.9	14.0
1958	8,278.1	588.0	1,057.4	591.0	2,605.9	663.8	922.9	318.5	386.9	1,143.8
	100.0	7.1	12.8	7.1	31.5	8.0	11.1	3.9	4.7	13.8
1959	8,826.6	571.2	1,201.7	665.6	2,509.1	801.1	1,064.4	395.9	457.5	1,251.4
	100.0	6.5	13.6	7.5	28.4	9.1	12.1	4.5	5.2	14.2
1960	8,980.8	577.0	1,231.7	666.8	2,560.4	799.6	1,070.5	424.3	453.6	1,196.9
	100.0	6.4	13.7	7.4	28.5	8.9	11.9	4.7	5.1	13.3

SUPPLEMENTARY TABLE 15

U.S. VALUE ADDED PROJECTIONS, FABRICATED METAL PRODUCTS (SIC 34)

SIC	Regression Equations*	1960 Actual	1970	1980	1900	2000	2010
1) 34	Y = 3376.0 + 57.10 X	8,980.8	12,455.0	16,338.0	21,705.0	29,642.0	39,409.0
2) 34	Y =-752.0 + 127.44 X - 261.0 t	8,980.8	13,247.0	19,303.0	28,672.0	43,776.0	62,959.0
3) Sum of 3-digit projections (below):		8,980.8**	12,141.5	16,281.4	22,246.3	31,214.8	42,408.0
341	Y = 1399.0 + 829.6 X + 197.1 log t	577.0	747.5	877.2	999.4	1,124.3	1,239.5
342	Y = 285.6 + 6.6076 X	1,231.7	1,489.7	1,874.3	2,383.7	3,111.2	4,022.4
343	Y = % approximation	666.8	695.9	782.7	1,069.4	1,500.6	2,038.4
344	Y = 721.0 + 41.77 X	2,560.0	3,624.0	4,773.0	6,297.0	8,499.0	11,251.0
345	Y = 165.2 + 6.447 X	799.6	1,190.3	1,628.7	2,234.7	3,130.8	4,233.3
346	Y = 80.2 + 13.812 X - 37.43 t	1,070.5	1,217.6	1,782.5	2,706.6	4,252.1	6,239.7
347	Y = -101.7 + 4.626 X	424.3	633.8	948.4	1,383.2	2,026.3	2,817.3
348	Y = -98.1 + 7.772 X - 19.83 t	453.6	661.7	991.9	1,524.2	2,406.2	3,536.9
349	Y = 146.6 + 10.908 X	1,196.9	1,881.0	2,622.7	3,648.1	5,164.3	7,029.5

*For an explanation of the regression equations, refer to Table XII.

**Parts may not add up to total due to rounding.

SUPPLEMENTARY TABLE 16

FABRICATED METALS INDUSTRY: OHIO RIVER BASIN VALUE ADDED AS A SHARE OF U.S. VALUE ADDED, 1947-1960

Year	U.S. SIC 34[1]	Basin SIC 34[2]	Basin as % of U.S.
	(millions of current dollars)		
1947	4,921.5	749.8	15.24
1949	4,834.2	737.2	15.25
1950	6,210.8	950.3	15.30
1951	7,138.6	1,099.8	15.41
1952	7,168.3	1,046.0	14.59
1953	8,143.7	1,190.6	14.62
1954	7,596.3	1,058.0	13.93
1955	8,404.3	1,236.7	14.72
1956	8,243.8	848.5	10.29
1957	9,453.8	1,325.0	14.02
1958	9,422.9	1,301.3	13.81
1959	10,444.6	1,559.6	14.93
1960	10,284.7	1,653.4	16.08

Notes:

1. From the 1947, 1954 and 1958 Census of Manufactures Volumes and Annual Survey of Manufactures series, unrevised for SIC changes because the Basin data have not been adjusted for SIC changes.

2. Value added figures are unrevised for SIC changes because such a revision would have to be done for each of the ten Basin states.

E. MACHINERY, EXCEPT ELECTRICAL (SIC 35)

1. Summary of Projections

As shown in Table XIII, we expect a 5.7-fold increase in the national output (value added) of the nonelectrical machinery industry between 1960 and 2010. During the same period, the projected growth in the Ohio River Basin will range between a 5.4-fold and a 6-fold increase. Both the national and the regional growth rates are projected to exceed that of the Gross National Product and to parallel that of the Federal Reverve Board Industrial Production Index.

2. Nature of the Industry

Approximately 60 percent of total value added in the Basin in the nonelectrical machinery industry is accounted for by four of the nine 3-digit industries (i.e., SIC 353, 354, 355, and 356). The Basin's 2-digit value added share of the United States has been declining during the postwar period, as shown in Supplementary Table 21 (from 16.71 percent in 1947 to 13.22 percent in 1960).

SIC	Industry Title	Percent distribution of 2-digit value added total, 1958	
		Ohio River Basin	United States
351	Engines and Turbines	17.13	8.62
352	Farm Machinery and Equipment	8.56	8.78
353	Construction, Mining, etc., Machinery	8.93	16.58
354	Metalworking Machinery	13.95	16.61
355	Special Industry Machinery	6.47	10.81
356	General Industry Machinery	14.04	15.62
357	Office, Computing Machines	15.27	7.83
358	Service Industry Machines	9.30	7.41
359	Miscellaneous Machinery, except Electrical	10.16	7.74
	Total*	100.00%	100.00%

*Parts may not add up to total due to rounding.

TABLE XIII

SUMMARY OF UNITED STATES AND OHIO RIVER BASIN VALUE ADDED PROJECTIONS, MACHINERY EXCEPT ELECTRICAL (SIC 35)*

(millions of 1954 dollars)

	1960 Actual	1970	1980	1990	2000	2010
U.S. Value Added Projections: (Sum of 3 digit projections)	11,501.5	18,956.9	26,025.6	35,316.5	48,794.6	65,197.4
Index (1960 = 100)	100	165	226	307	424	567
Ohio River Basin Value Added Projections:						
(1) ORB = 218.8 + 0.12947 (U.S.)	1,519.8	2,673.1	3,588.3	4,791.2	6,536.2	8,659.9
Index (1960 = 100)	100	176	236	315	430	570
(2) ORB = -12.20 + 0.17534(U.S.) - 35.25(t)	1,519.8	2,465.7	3,352.6	4,629.2	6,639.9	9,163.5
Index (1960 = 100)	100	162	221	305	437	603
(3) SUM of 3-digit Projections	1,519.8	2,614.5	3,483.0	4,614.3	6,251.9	8,225.8
Index (1960 = 100)	100	172	229	304	411	541

*For details, refer to accompanying text.

3. National Value Added Projections

a. Regression Analysis

The regression equations used in making 3-digit and 2-digit industry value added projections for the United States are presented in Table XIV. Value added series for each industry were plotted against a number of explanatory variables to determine which of these is most closely correlated to the particular industry series. Each industry was then regressed on the finally selected explanatory or independent variable. Two types of equations were fitted: (1) a simple linear regression equation of the form $Y = a + bX$, and (2) a multiple regression equation of the form $Y = a + b_1X_1 + b_2X_2$, where X_2 usually represents "time" as an additional explanatory variable.

In some cases several explanatory variables were tried alternatively until an acceptable fit was achieved. In a few instances where the possibility of a nonlinear relationship appeared, a semi- or double-logarithmic function was tried. But in general the best marriage of statistical significance and economic plausibility was obtained from a simple linear relationship. To derive projections for each decade, projected values of the explanatory variables were substituted into the equations. Thus, two sets of 2-digit value added projections were obtained from the first two equations in Table XIV. The other equations provided projections for the 3-digit industries, which, when summed each decade, provided a third set of national 2-digit value added projections.

The derivation of the historical data used in the regression analyses, as well as the derivation of the projected values of explanatory variables are explained below in detail. A summary of national value added projections is provided in Supplementary Table 20.

b. Value Added Data Selection and Adjustment

(1) Basic value added data at 4-digit industry detail were obtained from the 1947, 1954 and 1958 Census of Manufactures and the Annual Survey of Manufactures series for the period 1947-1960. No data were available for 1948.

(2) The 4-digit value added data were then adjusted for SIC changes in the standard industrial classification system that occurred in 1958, by using the adjustment factors presented in Supplementary Table 17. Computed from the data given in Appendix C of the 1958 Census of Manufactures, this adjustment schedule is applied to all pre-1958 years in order to make them conform to the post-1958 data which are given in terms of the new SIC code.

TABLE XIV

U.S. VALUE ADDED PROJECTIONS, MACHINERY EXCEPT ELECTRICAL (SIC 35)
REGRESSION EQUATIONS

SIC	Industry Title	Regression Equations*	R^2	Percent Level of Significance** (.01 = 1%)
35	Machinery, except Electrical	$Y_1 = 1960.00 + 226.54\ X$ (917.0) (22.27)	.946	Less than .01
		$Y_2 = 2647.00 + 171.06\ X + 197.50\ t$ (21.99) (37.40)	.960	" " "
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = Total Durables less household durables in billions of 1954 dollars		
		t = time (1947 = 1, . . . , 2010 = 64)		
351	Engines and Turbines	$Y = -2298.7 + 1563.5 \log X$ (491.8) (252.9)	.870	" " "
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = FRB industrial production index		
353	Construction, Mining, etc., Machinery	$Y = 787.7 + 25.804\ X$ (151.3) (11.84)	.488	" " "
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = GNP Construction Component in billions of 1954 dollars		

TABLE XIV (Continued)

SIC	Industry Title	Regression Equations*	R^2	Percent Level of Significance** (.01 = 1%)
354	Metalworking Machinery	$Y = 220.6 + 22.097\ X$ $(878.6)\ (9.856)$ where: Y = Value Added in millions of 1954 dollars X = FRB industrial production index	.501	Less than .01
355	Special Industry Machinery	$Y = 127.0 + 55.333\ X$ $(400.9)\ (18.22)$ where: Y = Value Added in millions of 1954 dollars X = Producers' Durable Equipment (GNP Component) in billions of 1954 dollars	.638	Less than .02
356	General Industry Machinery	$Y = 472.3 + 13.692\ X$ $(264.0)\ (2.961)$ where: Y = Value Added in millions of 1954 dollars X = FRB industrial production index	.793	Less than .01
357	Office, Computing Machinery	$Y = -3484.9 + 20.250 \log X$ $(616.0)\ (2.9367)$ where: Y = Value Added in millions of 1954 dollars X = GNP Services Component	.795	" " "

TABLE XIV (Continued)

SIC	Industry Title	Regression Equations*	R^2	Percent Level of Significance** (.01 = 1%)
358	Service Industry Machinery	$Y = -252.0 + 59.652\ X$ $(534.5)\ (24.279)$	.544	Less than .01
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = Producers' Durables - GNP Component in billions of 1954 dollars		
359	Miscellaneous Machinery	$Y = -672.1 + 15.210\ X$ $(116.0)\ (13.02)$	.958	" " "
		where:		
		Y = Value Added in millions of 1954 dollars		
		X = FRB Industrial production index		

*Variations in the number of significant digits in the equations arise from the fact that for purposes of convenience in presentation, value added is expressed in millions of dollars while GNP components are expressed in billions of dollars. In our regression analysis, however, these variables were expressed in different units (i.e., tens or hundreds of millions or billions) in order to minimize errors that might otherwise have been introduced by rounding. Estimated variance of the regression coefficients "a" and "b" is given underneath these coefficients in each equation.

**"Percent level of significance" states the probability that such a correlation would arise, by random sampling, from an uncorrelated population. In other words, a 1% level of significance for R (coefficient of correlation) may be interpreted as meaning that there is only one chance in a hundred of getting a value of R as high as that recorded when in fact the variables have zero correlation.

(3) The adjusted 4-digit value added data were then aggregated into 3-digit series which were then deflated in order to isolate real rather than price variations in output. For this purpose, price indexes were obtained as shown in Supplementary Table 18.

c. Explanatory Variables: Data Selection and Adjustment

The explanatory variables used in the regression analysis described above are listed for each regression equation in Table XIV. They can also be found in Appendix C. The deflated 2-digit and 3-digit United States value added series were related to these explanatory variables in order to make national projections of value added.

The 2-digit projections based upon the independent projections of 3-digit industry components were selected as the best forecast of the industry's national growth. As such, it became the base from which the Basin's share of the industry was derived.

4. Ohio River Basin Value Added Projections

a. Summary of Methodology and Results

Three sets of value added projections were obtained for the Ohio River Basin at the 2-digit level. The first two were obtained by regressing value added series for the Basin on United States value added series, using the value added data for the period 1947-1960. A third set of projections were obtained by estimating the Basin's percent share of each projected United States 3-digit value added, multiplying the projected United States value added levels by these projected Basin shares, and summing the results for each decade. The procedure is detailed below.

Two sets of 2-digit value added projections for the Ohio River Basin were obtained by substituting United States value added projections (sum of 3-digit projections) into the following regression equations:

$$\text{(a)}\quad \underset{}{\text{ORB}} = \underset{(57.9)}{218.8} + \underset{(0.02499)}{0.12947}\,(\text{U.S.}) \qquad R^2 = .683$$

$$\text{(b)}\quad \underset{}{\text{ORB}} = \underset{}{12.20} + \underset{(0.1437)}{0.17534}\,(\text{U.S.}) - \underset{(5.79)}{35.25}\,(t) \qquad R^2 = .925$$

where:

ORB = Value added in the Ohio River Basin in millions of 1954 dollars

U.S. = Value added in the United States in millions of 1954 dollars

t = time (1947 = 1, ... , 2010 = 64)

A third set of value added projections was obtained for the Basin at the 2-digit level by assuming that the Basin's percent share of national value added in each 3-digit industry will change at the same rate as its 2-digit share. For all 3-digit industries, the operational aspect of this assumption can be summarized as follows:

$$\left[\begin{array}{c}\text{ORB 3-digit value added in year n (1970, ... , 2010)}\end{array}\right] = \left[\begin{array}{c}\text{ORB percent share of U.S. 3-digit value added in 1960}\end{array}\right] \times \left[\begin{array}{c}\dfrac{\text{ORB \% share of U.S. 2-digit value added in year n}}{\text{ORB \% share of U.S. 2-digit value added in 1960}}\end{array}\right] \times \left[\begin{array}{c}\text{U.S. 3-digit value added projection}\end{array}\right]$$

where the Basin/U.S. 2-digit percent share is obtained for each decade by using the Basin value added projections derived through regression equation (a) given in the preceding paragraph (i.e., ORB = 218.8 + 0.12947 (U.S.)). The value added projections thus derived for each 3-digit industry were summed for each decade in order to obtain 2-digit Basin totals. The results are presented in Table XIII, as well as in Supplementary Table 22.

b. Value Added Data Selection and Adjustment

(1) Value added series at the 2-digit level were developed for the Basin for the period 1947-1961 from the 1947, 1954, and 1958 Census of Manufactures volumes and the Annual Survey of Manufactures series. This involved the following steps. First, we determined the employment level in the Basin part of each state and expressed it as a percent of total state employment in the nonelectrical machinery industry for the years 1940, 1950, and 1960, using Census of Population data. We then interpolated to find the intervening years.

Then, using these percent shares as weights, we allocated the 2-digit value added series for each state into the Basin part of the state. Summing the results for each year provided value added series for the Basin at the 2-digit level. Two important but inevitable assumptions were involved in this estimation procedure: (1) that the employment share of a sub-state area is the same as that area's value added share, where the State is the base, and (2) that changes in the employment share of each sub-state area lying within the Basin took place at a uniform rate in all the intervening years.

Since the boundaries of the Ohio River Basin are not coterminous with those of the states, and since historical value added data are not available at the county level, the estimation procedure described above is the best possible under the circumstances.

(2) After the 2-digit value added series had been developed for the Basin, they were adjusted for changes in standard industrial classification that occurred in 1958. We assumed that the percentage changes experienced by the national 2-digit industry as a consequence of adjustments for SIC changes were also applicable to the Basin's industry.

(3) The value added series adjusted for SIC changes were then deflated by implicit deflators at the 2-digit level derived for the national industry (See Supplementary Table 18) in order to isolate real rather than price variations in output.

(4) A reliable set of 3-digit value added data for the Basin were available only for 1958, the year for which the Bureau of the Census had prepared a special tabulation of the Census of Manufactures for the Basin area. We updated these value added totals to 1960, by applying to them the respective percentage growth rates experienced by the Basin states between 1958 and 1960.

SUPPLEMENTARY TABLE 17

ADJUSTMENTS MADE IN PRE-1958 VALUE ADDED SERIES TO ACCOUNT FOR THE 1958 INDUSTRIAL CLASSIFICATION CHANGES (SIC 35)

SIC	Add	Deduct
351	-	-
352	4.50% of 3563	52.39% of 3521
353	52.36% of 3521 88.57% of 3563 99.68% of 3565 100.00% of 3562	-
354	3.17% of 3599 60.16% of 3594 15.61% of 3589	1.63% of 3544 2.79% of 3541
355	4.68% of 3567	2.08% of 3559
356	100.00% of 3593 39.58% of 3594	17.58% of 3566 100.00% of 3563 100.00% of 3562 100.00% of 3565 4.68% of 3567 1.88% of 3561 + 19.29% of 3569
357	-	100.00% of 3575 23.55% of 3579 2.14% of 3571 + 5.54% of 3576
358	15.32% of 3579 100.00% of 3997 4.12% of 3439 3.79% of 3621	56.21% of 3589 41.20% of 3585 + 95.24% of 3584
359	-	100.00% of 3591 100.00% of 3592 100.00% of 3593 6.41% of 3599 100.00% of 3594

NOTE: All 4-digit SIC's shown above refer to the "old" SIC's (i.e., pre-1958).

Source: U. S. Bureau of the Census, 1958 Census of Manufactures, Appendix C.

SUPPLEMENTARY TABLE 18

DERIVED PRICE INDEX FOR THE MACHINERY (EXCEPT ELECTRICAL) INDUSTRY (SIC 35)

Years	Derived Sales Index (1954 = 100)	Derived Production Index (1954 = 100)	SIC 35 Price Index (1954 = 100)	Price Index for Agricultural Machinery and Equipment (SIC 352) (1954 = 100)
(1)	(2)	(3)	(4)	(5)
1947	61	86	71	73.9
1948	70	86	81	83.0
1949	63	73	86	88.6
1950	73	83	88	90.6
1951	96	105	91	98.3
1952	104	114	91	99.5
1953	110	117	94	100.1
1954	100	100	100	100.0
1955	108	108	100	100.8
1956	127	120	106	104.4
1957	133	116	115	109.3
1958	118	97	122	113.8
1959	144	115	125	117.3
1960	149	119	125	119.6

NOTES:

Column 2: Monthly average sales manufacturers in the nonelectrical machinery industry converted into index form. Derived from United States Department of Commerce, Business Statistics-1961 Edition, p. 21. The monthly series multiplied by 12, yield average annual sales. Dividing this series by the 1954 average yearly sales yields the sales index.

Column 3: Federal Reserve Board monthly production indexes can be obtained from the source cited for column 2, p. 14. The series were converted into a 1954 base (1954 = 100.0).

Column 4: Obtained by dividing column 2 by column 3.

Column 5: Ibid., p. 39. This series was used to deflate the SIC 352 (Agricultural Machinery and Equipment) value added data. In all other cases, the 2-digit derived deflators given in column 4 were used.

SUPPLEMENTARY TABLE 19

UNITED STATES VALUE ADDED SERIES, MACHINERY, EXCEPT ELECTRICAL (SIC 35)
(millions of 1954 dollars)

SIC 35 as percent of GNP; 3-digit components as percent of SIC 35

Years	SIC 35	351	352	353	354	355	356	357	358	359
1947 Value Added	9,743.2	542.2	825.9	1,538.4	1,678.2	1,477.8	1,541.0	657.4	1,100.2	382.0
	3.44	5.56	8.48	15.79	17.22	15.17	15.82	6.75	11.29	3.92
1949	7,944.6	534.9	893.1	1,230.5	1,168.2	1,206.7	1,224.0	506.9	921.0	259.2
	2.70	6.73	11.24	15.49	14.70	15.19	15.41	6.38	11.59	3.26
1950	8,587.2	536.7	902.7	1,299.1	1,428.6	1,243.3	1,215.7	573.8	1,063.7	323.8
	2.70	6.16	10.36	14.92	16.40	14.28	14.64	6.59	12.39	3.77
1951	10,928.1	641.8	1,028.1	1,804.4	2,080.1	1,499.2	1,663.5	641.2	1,044.3	525.5
	3.19	5.87	9.41	16.51	19.03	13.72	15.22	5.87	9.56	4.81
1952	12,589.9	814.2	1,078.8	2,066.1	2,801.6	1,477.8	1,807.4	695.4	1,182.4	666.2
	3.67	6.47	8.57	16.41	22.25	11.74	14.36	5.52	9.39	5.29
1953	12,658.6	826.0	975.9	2,064.9	2,880.8	1,364.2	1,797.7	730.2	1,233.5	785.4
	3.44	6.53	7.71	16.31	22.76	10.78	14.20	5.77	9.74	6.20
1954	10,918.7	690.1	792.7	1,650.7	2,445.4	1,211.3	1,618.7	718.7	1,105.6	685.4
	3.00	6.32	7.26	15.12	22.40	11.09	14.83	6.58	10.13	6.28
1955	12,182.2	751.3	916.4	2,067.7	2,447.2	1,339.2	1,859.6	778.2	1,251.3	771.3
	3.11	6.17	7.52	16.97	20.09	11.00	15.26	6.39	10.27	6.33
1956	13,452.7	787.1	897.9	2,389.1	2,905.8	1,513.5	1,969.0	869.3	1,266.1	854.7
	3.37	5.85	6.67	17.76	21.60	11.25	14.63	6.46	9.41	6.35
1957	12,314.7	834.3	829.4	2,134.9	2,504.3	1,339.9	1,831.2	968.8	1,077.6	794.3
	3.01	6.77	6.74	17.34	20.34	10.88	14.87	7.87	8.75	6.45
1958	10,156.7	875.4	891.7	1,684.3	1,686.9	1,098.0	1,586.2	795.5	752.6	786.1
	2.54	8.62	8.78	16.58	16.61	10.81	15.62	7.83	7.41	7.74
1959	11,635.5	900.5	937.8	1,924.3	1,991.9	1,266.8	1,887.2	921.9	880.6	924.5
	2.71	7.74	8.06	16.54	17.12	10.89	16.22	7.92	7.57	7.95
1960	11,501.5	799.7	752.8	1,730.0	2,150.1	1,409.9	1,828.1	1,035.8	874.4	920.7
	2.61	6.95	6.54	15.04	18.69	12.26	15.89	9.01	7.60	8.00

SUPPLEMENTARY TABLE 20

UNITED STATES VALUE ADDED PROJECTIONS, MACHINERY, EXCEPT ELECTRICAL (SIC 35)
(millions of 1954 dollars)

	SIC	Regression Equations*	1960 Actual	1970	1980	1990	2000	2010
(1)	SIC 35:	Y = 1960.00 + 226.54X	11,501.5	19,403.6	27,332.5	37,934.6	52,116.0	70,918.8
(2)	SIC 35:	Y = 2647.00 + 171.06X + 197.50t	11,501.5	20,558.6	28,520.7	38,501.3	51,184.7	67,357.7
(3)	Sum of 3-digit projections (below):		11,501.5	18,956.9	26,025.6	35,316.5	48,794.6	65,197.4
	SIC 351:	Y = -2298.7 + 1563.5 log X	799.7	1,143.2	1,384.9	1,620.2	1,864.6	2,079.1
	SIC 352:	(See text)	752.8	1,639.7	2,267.4	3,080.2	4,230.1	5,618.4
	SIC 353:	Y = 787.7 + 25.804 X	1,730.0	2,581.1	3,290.7	4,232.5	5,592.4	7,292.9
	SIC 354:	Y = 220.6 + 22.097 X	2,150.1	3,734.0	5,236.6	7,313.7	10,385.2	14,163.8
	SIC 355:	Y = 127.0 + 55.333 X	1,409.9	2,207.5	3,032.0	4,122.0	5,693.5	7,668.9
	SIC 356:	Y = 472.3 + 13.692 X	1,828.1	2,649.3	3,580.4	4,867.4	6,770.6	9,112.0
	SIC 357:	Y = -3484.9 + 20.250 log X	1,035.8	1,264.9	1,573.3	1,815.3	2,184.7	2,458.3
	SIC 358:	Y = -252.0 + 59.652 X	874.4	1,990.9	2,879.7	4,054.9	5,749.0	7,878.6
	SIC 359:	Y = -672.1 + 15.210 X	920.7	1,746.3	2,780.6	4,210.3	6,324.5	8,925.4

*For an explanation of the regression equations, refer to Table XIV.

SUPPLEMENTARY TABLE 21

OHIO RIVER BASIN VALUE ADDED SERIES,
MACHINERY EXCEPT ELECTRICAL (SIC 35)
(millions of 1954 dollars)

Years	Value Added	Percent of United States Value Added
1947	1,628.3	16.71
1949	1,271.1	16.00
1950	1,426.6	16.61
1951	1,783.5	16.32
1952	1,929.0	15.32
1953	1,904.1	15.04
1954	1,593.8	14.60
1955	1,742.7	14.31
1956	2,076.6	15.44
1957	1,881.1	15.28
1958	1,288.8	12.69
1959	1,521.2	13.07
1960	1,519.8	13.22

SUPPLEMENTARY TABLE 22

OHIO RIVER BASIN VALUE ADDED PROJECTIONS, MACHINERY EXCEPT ELECTRICAL
(millions of 1954 dollars)

	1960 Actual	1970	1980	1990	2000	2010
(1) ORB = 218.8 + 0.12947 (U.S.)	1,519.8	2,673.1	3,588.3	4,791.2	6,536.2	8,659.9
(2) ORB = -12.20 + 0.17534 (U.S.) - 35.25(t)	1,519.8	2,465.7	3,352.6	4,629.2	6,639.9	9,163.5
(3) Sum of 3-digit projections (below):	1,519.8	2,614.5	3,483.0	4,614.3	6,251.9	8,225.8
SIC 351	175.1	267.1	316.6	364.4	413.9	457.4
SIC 352	81.3	188.9	255.5	341.6	463.2	609.6
SIC 353	195.0	310.2	387.0	489.7	638.7	825.6
SIC 354	315.4	584.4	801.7	1,101.4	1,544.3	2,087.7
SIC 355	92.9	155.2	208.3	278.6	380.3	507.7
SIC 356	300.7	465.0	614.8	822.1	1,129.3	1,506.2
SIC 357	159.8	208.1	253.1	287.4	341.5	380.8
SIC 358	93.0	226.0	319.6	442.8	619.7	842.2
SIC 359	106.6	209.6	326.4	486.3	721.0	1,008.6

F. ELECTRICAL MACHINERY (SIC 36)

1. Summary of Projections

As shown in Table XV, the U. S. value added in the electrical machinery industry is projected to increase about 6.7-fold between 1960 and 2010. The Ohio River Basin, which has accounted for over 16 percent of national value added in the electrical machinery industry during the postwar period, is expected to increase its share of the national industry's output. By 2010, the Basin's value added in the electrical machinery industry is projected to increase 6.5 to 7.5-fold. Two of the three sets of projections prepared for the Basin show growth rates that exceed the rates projected for the nation.

2. Nature of the Industry

A comparison of the 3-digit value added composition of the Basin's electrical machinery industry with that of the United States shows that the household appliance industry (SIC 363) is of much greater relative importance in the region than in the nation for it accounts for 35.3 percent of the Basin's total value added in the electrical machinery industry.

SIC	Industry Title	Percent Distribution of 2-Digit Value Added Total, 1958	
		U. S.	ORB
361	Electric distribution products	12.2%	12.7%
362	Electric industrial apparatus	13.2	12.3
363	Household appliances	17.8	35.3
364	Lighting and wiring devices	10.7	11.5
365	Radio, TV, receiving equipment	7.7	8.2
366	Communication equipment	18.6	4.9
367	Electric components	19.7	15.2
369	Electrical products, n.e.c.		
		100.0%	100.0%

As shown in the tabulation above, in five of the eight 3-digit industries the Basin accounts for over 20 percent of national value added. In SIC 363 (Household Appliances), the Basin accounts for about 38 percent of national value added. In short, the Basin is and will continue to be an important area of electrical machinery production.

TABLE XV

SUMMARY OF U. S. AND OHIO RIVER BASIN VALUE ADDED PROJECTIONS

Electrical Machinery (SIC 36)*
(in millions of 1954 dollars)

	1960 (actual)	1970	1980	1990	2000	2010
U. S. Value Added Projections: (sum of 3-digit projections)	11,336.7	17,453.5	26,149.0	37,998.0	55,184.5	76,628.6
Index (1960=100)	100	154	231	335	487	676
Ohio River Basin Value Added:						
(1) ORB=38.5+0.1689 (U. S.)	1,799.5	2,986.4	4,455.1	6,456.4	9,359.2	12,981.1
Index (1960=100)	100	166	248	359	520	721
(2) ORB=3.5+0.1872 (U. S.) -13.87 (time)	1,799.5	2,938.1	4,427.3	6,506.8	9,585.6	13,461.4
Index (1960=100)	100	163	246	362	533	748
(3) SUM of 3-digit Projections	1,799.5	2,763.9	4,095.2	5,892.8	8,479.5	11,725.9
Index (1960=100)	100	154	228	327	471	652

*For details, refer to accompanying text.

3-DIGIT VALUE ADDED COMPOSITION OF THE
ELECTRICAL MACHINERY INDUSTRY (SIC 36), OHIO RIVER BASIN

SIC	1958 Basin 3-digit	1958 % of U. S. 3-digit
361	223,475	20.13
362	216,614	18.04
363	622,237	38.40
364	202,304	20.73
365	143,640	20.40
366	86,204	5.10
367	140,896	11.85
369	126,236	21.02
Total SIC 36 (sum of 3-digits)	1,761,606	19.38

3. National Value Added Projections

a. Regression Analysis

The regression equations used in making 3-digit and 2-digit industry value added projections for the United States are presented in Table XVI. Value added series for each industry were plotted against a number of explanatory variables to determine which of these is most closely correlated to the particular industry series. Each industry was then regressed on the finally selected explanatory or independent variable. Two types of equations were fitted: (1) a simple linear regression equation of the form $Y = a + bX$, and (2) a multiple regression equation of the form $Y = a + b_1X_1 + b_2X_2$, where X_2 usually represents "time" as an additional explanatory variable.

In some cases several explanatory variables were tried alternatively until an acceptable fit was achieved. In a few instances where the possibility of a nonlinear relationship appeared, a semi- or double-logarithmic function was tried. But in general the best marriage of statistical significance and economic plausibility and consistency was obtained from a simple linear relationship.

To derive projections for each decade, projected values of the explanatory variables were substituted into the equations. Thus, two sets of 2-digit value added projections were obtained from the first two equations in Table XVI. The other equations provided projections for the 3-digit industries, which, when summed each decade, provided a third set of national 2-digit value added projections.

The derivation of the historical data used in the regression analyses, as well as the derivation of the projected values of explanatory variables are explained below in detail. A summary of national value added projections is provided in Supplementary Table 26.

b. Value Added Data Selection and Adjustment

(1) Basic value added data at 4-digit industry detail were obtained from the 1947, 1954 and 1958 Census of Manufactures and the Annual Survey of Manufactures series, for the period 1947-1960. No data were available for 1948.

(2) The 4-digit value added data were then adjusted for SIC changes in the standard industrial classification system that occurred in 1958, by using the adjustment factors presented in Supplementary Table 23. Computed from the data given in Appendix C of the 1958 Census of Manufactures, this adjustment schedule is applied to all pre-1958 years in order to make them conform to the post-1958 data which are given in terms of the new SIC code.

(3) The adjusted 4-digit value added data were then aggregated into 3-digit series which were then deflated in order to isolate real rather than price variations in output. For this purpose, price indexes were obtained as shown in Supplementary Table 24.

c. Explanatory Variables: Data Selection and Adjustment

The explanatory variables used in the regression analysis described above are listed for each regression equation in Table XVI. They can also be found in Appendix C. The deflated 2-digit and 3-digit U. S. value added series were related to these explanatory variables in order to make national projections of value added.

The 2-digit projections based upon the independent projections of 3-digit industry components were selected as the best forecast of the industry's national growth. As such, it became the base from which the Basin's share of the industry was derived.

TABLE XVI

U.S. VALUE ADDED PROJECTIONS, ELECTRICAL MACHINERY (SIC 36)
REGRESSION EQUATIONS

SIC	Industry Title	Regression Equations*	R^2	Percent Level of Significance** (.01=1%)
36	Electrical Machinery	$Y = -2468.0 + 124.36\ X$ (656.0) (7.42)	.98	.01
		$Y = -1589.0 + 109.38\ X + 55.6\ t$ (24.51) (86.6)	.98	.01
		where: Y = Value Added in millions of 1954 dollars; X = FRB index of industrial production; t = Time (1947=1, . . . , 2010 = 64)		
361	Electric Distribution Products	$Y = -237.6 + 14.847\ X$ (138.9) (1.555)	.88	.01
		where: Y = Value Added in millions of 1954 dollars; X = FRB index of industrial production		
362	Electric Industrial Apparatus	$Y = 142.7 + 15.589\ X$ (183.0) (2.437)	.78	.01
		where: Y = Value Added in millions of 1954 dollars; X = Total Durable Goods (GNP Component) in billions of 1954 dollars		
363	Household Appliances	$Y = -45.8 + 44.144\ X$ (157.8) (4.605)	.88	.01
		where: Y = Value Added in millions of 1954 dollars; X = Consumer Durables (GNP Component) in billions of 1954 dollars		

(Continued)

TABLE XVI (Continued)

SIC	Industry Title	Regression Equations*	R^2	Percent Level of Significance** (.01=1%)
364	Lighting and Wiring Devices	$Y = 9.4 + 12.725\ X$ $(122.5)\ (1.631)$ where: Y = Value Added in millions of 1954 dollars X = Total Durable Goods (GNP Component) in billions of 1954 dollars	.83	.01
365	Radio and TV Receiving Equipment	$Y = -666.7 + 13.632\ X$ $(125.3)\ (1.411)$ where: Y = Value Added in millions of 1954 dollars X = FRB index of industrial production	.89	.01
366	Communications Equipment	$Y = -851.9 + 26.804\ X$ $(267.2)\ (2.997)$ where: Y = Value Added in millions of 1954 dollars X = FRB index of industrial production	.87	.01
367 369	Electrical Components Electrical Products n.e.c.	$Y = -955.0 + 29.537\ X$ $(310.0)\ (3.479)$ where: Y = Combined Value Added in millions of 1954 dollars X = FRB index of industrial production	.86	.01

*Variations in the number of significant digits in the equations arise from the fact that for purposes of convenience in presentation, value added is expressed in millions of dollars while GNP components are expressed in billions of dollars. In our regression analysis, however, these variables were expressed in different units (i.e., tens or hundreds of millions or billions) in order to minimize errors that might otherwise have been introduced by rounding. Estimated variance of the regression coefficients "a" and "b" is given underneath these coefficients in each equation.

**"Percent level of significance" states the probability that such a correlation would arise, by random sampling, from an uncorrelated population. In other words, a 1% level of significance for R (coefficient of correlation) may be interpreted as meaning that there is only one chance in a hundred of getting a value of R as high as that recorded when in fact the variables have zero correlation.

4. Ohio River Basin Value Added Projections

a. Summary of Methodology and Results

Three sets of value added projections were obtained for the Ohio River Basin at the 2-digit level. The first two were obtained by regressing value added series for the Basin on U.S. value added series, using the value added data for the period 1947-1960. A third set of projections were obtained by estimating the Basin's percent share of each projected U.S. 3-digit value added, multiplying the projected U.S. value added levels by these projected Basin shares, and summing the results for each decade. The procedure is detailed below.

Two sets of 2-digit value added projections for the Ohio River Basin were obtained by substituting U.S. value added projections (sum of 3-digit projections) into the following regression equations:

(a) $$\underset{(46.9)\ (0.0064)}{ORB = 38.5 + 0.1689\ (U.S.)} \qquad R^2 = .960$$

(b) $$\underset{(0.0116)\qquad (5.66)}{ORB = 3.5 + 0.1872\ (U.S.) - 13.87\ (t)}$$

where:

ORB = Value added in the Ohio River Basin in millions of 1954 dollars

U.S. = Value added in the United States in millions of 1954 dollars

t = time (1947=1, . . . , 2010=64)

A third set of 2-digit value added projections was obtained for the Basin by assuming that the Basin's percent share of national value added in each 3-digit industry will change at the same rate as its 2-digit share. For all 3-digit industries, the operational aspect of this assumption can be summarized as follows:

$$\left[\begin{array}{c}\text{ORB 3- digit value added in year n (1970, . . . , 2010)}\end{array}\right] = \left[\begin{array}{c}\text{ORB percent share of U.S. 3-digit value added in 1960}\end{array}\right] X \left[\begin{array}{c}\dfrac{\text{ORB \% share of U.S. 2-digit value added in year n}}{\text{ORB \% share of U.S. 2-digit value added in 1960}}\end{array}\right] X \left[\begin{array}{c}\text{U.S. 3-digit value added projection}\end{array}\right]$$

where the Basin/U.S. 2-digit percent share is obtained for each decade by using the Basin value added projections derived through regression equation (a) given in the preceding paragraph (i.e., ORB = 38.5 + 0.1689 (U.S.)). The value added projections thus derived for each 3-digit industry were summed for each decade in order to obtain 2-digit Basin totals. The results are presented in Table XV, as well as in Supplementary Table 28.

b. Value Added Data Selection and Adjustment

(1) Value added series at the 2-digit level were developed for the Basin for the period 1947-1961 from the 1947, 1954, and 1958 Census of Manufactures volumes and the Annual Survey of Manufactures series. This involved the following steps. First, we determined the employment level in the Basin part of each state and expressed it as a percent of total state employment in the electrical machinery industry for the years 1940, 1950, and 1960, using Census of Population data. We then interpolated to find the intervening years. Then, using these percent shares as weights, we allocated the 2-digit value added series for each state into the Basin part of the state. Summing the results for each year provided value added series for the Basin at the 2-digit level. Two important but inevitable assumptions were involved in this estimation procedure: (1) that the employment share of a sub-state area is the same as that area's value added share, where the State is the base, and (2) that changes in the employment share of each sub-state area lying within the Basin took place at a uniform rate in all the intervening years.

Since the boundaries of the Ohio River Basin are not coterminous with those of the states, and since historical value added data are not available at the county level, the estimation procedure described above is the best possible under the circumstances.

(2) After the 2-digit value added series had been developed for the Basin, they were adjusted for changes in standard industrial classification that occurred in 1958. We assumed that the percentage changes experienced by the national 2-digit industry as a consequence of adjustments for SIC changes were also applicable to the Basin's industry.

(3) The value added series adjusted for SIC changes were then deflated by implicit deflators at the 2-digit level derived for the national industry (see Supplementary Table 23) in order to isolate real rather than price variations in output.

(4) A reliable set of 3-digit value added data for the Basin were available only for 1958, the year for which the Bureau of the Census had prepared a special Census of Manufactures tabulation for the Basin area. We updated these value added totals to 1960, by applying to them the respective percentage growth rates experienced by the Basin states between 1958 and 1960.

SUPPLEMENTARY TABLE 23

ELECTRICAL MACHINERY INDUSTRY (SIC 36)
ADJUSTMENTS IN VALUE ADDED FOR SIC RECLASSIFICATION

	New SIC	Composed of Old SIC	% of New in Old
361	3611	3613	99.78
	3612	3615	99.76
	3613	3616	66.31
362	3621	3614	100.00
	3622	3616	33.68
	3623	3617	100.00
	3624	3612	100.00
	3629	3619	88.77
363	3631	3439	17.02
		3621	17.06
	3632	3585	41.20
	3633	3581	99.88
	3634	3621	71.92
	3635	3584	94.21
	3636	3583	100.0
	3639	3439	12.57
		3589	40.10
		3621	2.47
364	3641	3651	100.00
	3642	3471	99.66
	3643	3611	54.64
		3661	1.34
	3644	3611	45.24
365	3651	3661	22.91
	3652	3663	100.00
366	3661	3664	99.86
	3662	3661	46.28
		3669	97.56
367	3671	3662	38.58
	3672	3662	9.10
	3673	3662	22.38
	3679	3661	27.76
		3662	29.83
369	3691	3691	100.00
	3692	3692	100.00
	3693	3693	100.00
	3694	3641	99.95
	3699	3699	73.39
		3669	2.42

Source: U.S. Bureau of the Census, 1958 Census of Manufactures, Appendix C.

SUPPLEMENTARY TABLE 24

BUREAU OF LABOR STATISTICS WHOLESALE PRICE INDEXES USED TO DEFLATE ELECTRICAL MACHINERY INDUSTRY VALUE ADDED

	Electrical Machinery & Equipment BLS Code 11-7	Household Appliances 12-4	TV, Radio Receivers & Phonographs - 12-5
1947	76.2	88.6	99.6
1948	79.8	92.9	103.6
1949	81.8	92.3	107.2
1950	84.4	93.0	100.2
1951	96.6	98.5	96.1
1952	95.3	98.0	96.0
1953	98.0	98.9	99.0
1954	100.0	100.0	100.0
1955	101.6	97.5	96.2
1956	109.6	96.2	96.3
1957	118.1	96.2	97.7
1958	120.6	95.6	97.6
1959	122.4	95.5	96.0
1960	121.9	92.9	94.5
	This Index was used to deflate SIC's:	This Index was used to deflate SIC 363	This Index was used to deflate SIC 365
	36		
	361		
	362		
	364		
	366		
	367		
	369		

SUPPLEMENTARY TABLE 25

U.S. VALUE ADDED SERIES, ELECTRICAL MACHINERY (SIC 36)
(millions of 1954 dollars)

Year	SIC 36	361	362	363	364	365	366	367 & 369
1947	5,913.9	703.4	1,074.8	1,108.1	770.6	253.8	1,033.3	969.9
1949	5,452.5	749.1	992.0	972.7	620.4	231.2	906.2	980.8
1950	6,685.9	748.8	1,053.8	1,320.0	864.1	321.3	1,052.8	1,325.3
1951	6,878.4	894.5	1,228.8	1,203.4	908.1	335.3	1,024.6	1,283.7
1952	8,199.9	1,083.3	1,483.3	1,266.1	910.5	473.0	1,436.6	1,547.1
1953	9,124.8	1,220.2	1,546.4	1,340.9	995.6	583.0	1,650.3	1,788.4
1954	8,482.9	1,121.9	1,318.9	1,382.3	910.9	545.4	1,548.1	1,655.3
1955	9,161.4	1,106.2	1,362.0	1,608.8	1,077.8	558.2	1,644.8	1,803.4
1956	9,718.2	1,294.2	1,590.8	1,783.4	1,053.1	585.8	1,690.8	1,720.3
1957	9,450.8	1,289.1	1,481.4	1,588.2	1,010.6	657.7	1,734.3	1,689.3
1958	9,089.8	1,110.0	1,200.5	1,620.1	975.7	703.9	1,690.2	1,789.4
1959	10,824.1	1,294.9	1,426.9	1,820.0	1,159.6	853.1	1,896.5	2,373.1
1960	11,336.7	1,296.2	1,437.9	1,799.2	1,176.1	840.2	2,308.3	2,478.8

SUPPLEMENTARY TABLE 26

U.S. VALUE ADDED PROJECTIONS, ELECTRICAL MACHINERY (SIC 36)
(millions of 1954 dollars)

SIC Regression Equations*	1960 Actual	1970	1980	1990	2000	2010
(1) SIC 36 Y = -2468.0 + 124.36 X	11,336.7	17,305	25,762	37,452	54,738	76,003
(2) SIC 36 Y = -1589.0 + 109.38 X +55.6t	11,336.7	17,133	25,126	35,962	51,719	70,975
(3) SUM of 3-digit projections (Below)	11,336.7	17,453.5	26,149.0	37,998.0	55,184.5	76,628.6
SIC 361 Y = -237.6 + 14.847 X	1,296.2	2,123.1	3,132.7	4,528.3	6,592.0	9,130.9
SIC 362 Y = 142.7 + 15.589 X	1,437.9	2,317.0	3,292.3	4,588.0	6,367.4	8,679.6
SIC 363 Y = -45.8 + 44.144 X	1,799.2	2,607.3	3,777.1	5,317.7	7,507.2	10,279.5
SIC 364 Y = 9.4 + 12.725 X	1,176.1	1,754.0	2,536.6	3,576.2	5,004.0	6,859.3
SIC 365 Y = -666.7 + 13.632 X	840.2	1,500.8	2,427.8	3,709.2	5,604.0	7,935.1
SIC 366 Y = -851.9 + 26.804 X	2,308.3	3,409.9	5,232.6	7,752.2	11,477.9	16,061.4
SIC 367 + SIC 369 Y = -995.0 + 29.537 X	2,478.8	3,741.4	5,749.9	8,526.4	12,632.0	17,682.8

* For an explanation of the regression equations, refer to Table XVI.

SUPPLEMENTARY TABLE 27

OHIO RIVER BASIN VALUE ADDED SERIES, ELECTRICAL MACHINERY (SIC 36)
(millions of 1954 dollars)

	U.S. SIC 36[1]	Basin SIC 36[2]	Basin as Percent of U.S.
	(millions of current $)		
1947	3,860.2	633.3	16.40
1949	3,901.7	669.4	17.16
1950	4,815.4	894.5	18.58
1951	5,753.2	1,057.2	18.38
1952	6,873.2	1,268.9	18.46
1953	7,876.2	1,419.2	18.02
1954	7,403.1	1,291.0	17.44
1955	7,739.6	1,328.3	17.16
1956	9,112.0	1,454.2	15.96
1957	9,620.4	1,594.4	16.57
1958	10,395.4	1,856.0	17.85
1959	12,533.9	2,229.7	17.79
1960	13,068.7	2,193.6	16.79

NOTES:

1. From the 1947, 1954 and 1958 Census of Manufactures and Annual Survey of Manufactures series, unrevised for SIC changes since Basin data are unrevised.
2. Value added figures are unrevised for SIC changes because such a revision would be required for each of the 10 Basin states.

SUPPLEMENTARY TABLE 28

OHIO RIVER BASIN VALUE ADDED PROJECTIONS, ELECTRICAL MACHINERY (SIC 36)
(millions of 1954 dollars)

	1960 Actual	1970	1980	1990	2000	2010
(1) ORB = 38.5 + 0.1689 (U.S.)	1,799.5	2,986.4	4,455.1	6,456.4	9,359.2	12,981.1
(2) ORB = 3.5 + 0.1872 (U.S.) -13.87 (t)	1,799.5	2,938.1	4,427.3	6,506.8	9,585.6	13,461.4
(3) SUM of 3-digit projections	1,799.5	2,763.9	4,095.2	5,892.8	8,479.5	11,725.9
SIC 361	228.4	374.1	552.0	797.9	1,161.5	1,608.9
SIC 362	221.3	356.6	506.7	706.1	979.9	1,335.8
SIC 363	635.6	921.2	1,334.4	1,878.7	2,652.3	3,631.7
SIC 364	206.6	304.2	445.7	628.3	879.2	1,205.2
SIC 365	146.7	262.0	423.9	647.6	978.5	1,385.5
SIC 366	88.0	129.9	199.4	295.4	437.3	611.9
SIC 367 + 369	173.0	411.9	633.1	938.8	1,390.8	1,946.9

APPENDIX L

SUBAREA PROFILES

SUBAREA A -- ALLEGHENY

Contained entirely within western Pennsylvania and roughly coextensive with the drainage basin of the Allegheny River, this subarea is in the midst of an economic transition which is likely to continue in the first two decades of the projection period. In 1930, mining accounted for over 20 percent of total employment, and most of these jobs were in the coal mines. By 1960, mining had dropped to 6 percent, and in 1980 it is expected that only 3 percent of the subarea's employed population will be engaged in mining. Since most of Pennsylvania's oil wells are located in this subarea, the recovery of petroleum will continue to account for a significant share of total mining employment.

Within the manufacturing sector, the production of steel (in the Johnstown metropolitan area) has traditionally been the main source of employment (36 percent of total manufacturing employment in 1940). We foresee a substantial absolute decline in jobs in the primary metals group (which includes steel) from about 22,000 workers in 1960 to about 14,000 in 1980. Moreover, significant shift is foreseen in the mix of manufacturing industries in the subarea. Fabricated metal products and electrical machinery are expected to grow at a rapid rate and may account for over 40 percent of total manufacturing employment by 1980. Apparel, too, may be viewed as a growth industry as firms in this group move out of the seaboard metropolitan centers.

Subarea A is not highly urbanized and is likely to remain more rural than the Ohio River Basin as a whole due to its rugged topography and relative difficulty of access. Nevertheless, almost half of the subarea's projected 1980 population of 922,000 can be expected to live in urban areas and to require a higher level of services than is presently available in the area.

SUBAREA B -- MONONGAHELA

Lying athwart southwestern Pennsylvania, northern West Virginia and the westernmost tip of Maryland, this subarea is coextensive with the drainage basin of the Monongahela River and its tributaries above the Pittsburgh metropolitan area. The subarea is contained within the Appalachian Plateau, where transportation and economic activity are concentrated within deeply dissected river valleys. Coal mining has been the mainstay of the economy; in 1930, mining accounted for 28 percent of total employment; by 1960, however, increases in

productivity had left their mark, with only 14 percent of all workers employed in mining. We foresee a continuation of this decline, at least to 1980, in both relative and absolute terms. In that year, mining may account for only 6 percent of total employment, even though the output of the mines can be expected to increase by 75 percent in constant dollar terms.

The drastic decline in mining employment will be balanced by a substantial increase in manufacturing and service employment. Manufacturing, which in 1930 accounted for less than 15 percent of total employment, has assumed a more important role in the subarea's economy; it can be expected to provide about 20 percent of all the jobs during the early part of the projection period. The principal growth industries are lumber and furniture, machinery, and apparel.

However, because of the area's relative inaccessibility and the continued erosion of employment opportunities in its principal resource-based activities, we foresee virtually no growth in the area's population and labor force except, perhaps, in the counties bordering on the Pittsburgh SMSA.

SUBAREA C -- PITTSBURGH SMSA

This subarea, which is coextensive with the Census definition of the Pittsburgh metropolitan area, lies at the confluence of the navigable Allegheny and Monongahela rivers where the Ohio is formed and flows on a westerly course. This is the most populous of the subareas delineated for the projective economic study of the Ohio River Basin and it contains the largest urban complex in the Basin. Its 1960 population accounts for more than 12 percent of the Basin's population; however, by 2010, this metropolitan area will hold only a little more than 10 percent of the Basin's population, according to our projections.

The relative population and labor force decline projected for this subarea is due, in large part, to a relative as well as an absolute decrease in employment opportunities in mining and manufacturing. Mining, which 30 years ago accounted for 7 percent of the area's total employment, has declined to 1.4 percent in 1960, and will decrease further to less than 1 percent of total employment by 1980. Manufacturing has been able to maintain its share of total employment between 1930 and 1960 (between 37 and 38 percent), but as a result of anticipated productivity increases this share will decline to less than 30 percent by 1980. The most significant absolute decrease in jobs is foreseen for the primary metals industry, and modest increases in the fabricated metals and machinery sectors are not expected to balance the decrease in steel production jobs. (The Pittsburgh area, however, can be expected to maintain and even to expand its volume of steel production as technological change improves the area's relative costs of production.)

Even though employment opportunities in the trades, the services, and particularly in finance, insurance and real estate are projected to increase, the population of this metropolitan area will grow quite slowly during the next 20 years; an increase of only 10 percent is foreseen for the period 1960-1980. For comparison with the results of a much more detailed study of this area, see the 4-volume Economic Study of the Pittsburgh Region, published for the Pittsburgh Regional Planning Association by the University of Pittsburgh Press, 1963-64.

SUBAREA D -- BEAVER

This small subarea encompasses the headwater tributaries of the Beaver River and thus includes the Youngstown metropolitan area. Situated astride the Lake Erie - Ohio River valley transportation corridor, the subarea has a highly specialized economy with 44 percent of its working population engaged in manufacturing, notably in the production of steel. Since employment opportunities in this industry sector are not favorable due to anticipated sharp increases in productivity, this subarea must seek alternative sources of employment in order to retain its population. Thus we project a continued decline in the primary metals sector from about 64,000 jobs in 1960 to less than 40,000 jobs in 1980, but a substantial increase in the machinery and electrical machinery sectors from about 23,000 jobs in 1960 to perhaps 35,000 in 1980. The total population of the subarea is projected to increase by 12 percent during the 20-year period, a rate which implies substantial out-migration.

SUBAREA E -- UPPER OHIO

This subarea was delineated along the mainstem of the Ohio River from the western border of Pennsylvania to the mouth of the Hocking River; it therefore lies partly in Ohio and partly in West Virginia. Both agriculture and mining have suffered sharp declines in employment between 1930 and 1960 in this section of the valley; together they accounted for 26 percent of total employment in 1930 and only 7 percent in 1960. Manufacturing has become a more important sector of the economy with primary metals responsible for over 40 percent of total employment in manufacturing. Since this industry sector can be expected to contract in terms of employment numbers due to anticipated increases in productivity, we foresee a gradual absolute decline in manufacturing employment between 1960 and 1980.

Subarea E contains two standard metropolitan areas: Steubenville - Weirton and Wheeling. These steel-manufacturing centers are not expected to experience significant growth due, in part, to the fact that most of the floodplain areas are preempted by existing urban and industrial development. We have projected a slight decline in the total population of the Wheeling SMSA and only a

modest increase in the population of the Steubenville-Weirton area. In 1980, these SMSA's can be expected to account for one-half of the subarea's total population. Economic expansion, therefore, is likely to occur in the Ohio River counties downstream from these urban centers. A significant rate of out-migration is likely to keep the subarea's total population near its present level of 700,000.

SUBAREA F -- MUSKINGUM

This subarea lies entirely within Ohio; it embraces the drainage basin of the Muskingum River. The decline in agricultural employment since 1930 has been more than balanced by the growing importance of manufacturing in this area. Within the manufacturing sector, fabricated metal products and electrical machinery have increased considerably in employment, while employment in primary metals has declined in relative terms from 38 percent of total manufacturing employment in 1940 to 18 percent in 1960. Canton, the only SMSA in the subarea, accounts for most of the primary metals activity. Since important increases in productivity are anticipated in this industry, we foresee a further slight absolute decline in primary metals employment, while total output is expected to increase by about 30 percent between 1960 and 1980, in constant dollar terms. At the same time, employment in the machinery and electrical machinery industries is likely to double and employment in the production of fabricated metals is also expected to increase sharply. As a result of these anticipated shifts, manufacturing will continue as a major source of employment in the subarea and will pace a substantial increase in total population. Subarea F is projected to experience a 30 percent increase in population between 1960 and 1980, which represents a continuation of the growth rate of the 1950's; its share of the Basin's total population, which was 5 percent in 1940 and 5.5 percent in 1960, can be expected to reach 6.5 percent in 1980.

SUBAREA G -- KANAWHA-LITTLE KANAWHA

This subarea embraces the drainage basins of two major Ohio River tributary streams; it lies principally in West Virginia, but also includes several Great Valley and Blue Ridge counties in western Virginia and North Carolina which are drained by the New River, a headwater stream of the Kanawha.

Economically, this subarea is focused on Charleston, W. Va., where the chemical industry constitutes the basic manufacturing activity. Mining is still an important sector in this part of the Appalachian Plateau, even though it has declined as a source of jobs from 20 percent of total employment in 1940 to 9 percent in 1960; by 1980, mining is expected to account for just over 4 percent of total employment. Manufacturing, on the other hand, will continue as a growth sector, with chemicals, lumber and furniture, and apparel accounting for the

largest shares of total manufacturing employment. The chemical industry, in particular, is projected to more than double its output during the 1960-1980 period; yet because of further rises in productivity levels, employment in that industry can be expected merely to hold its own. Agricultural employment continues to decline rapidly as marginal farm operations are discontinued; in 1930 agriculture accounted for more than 30 percent of total employment in the subarea, in 1960 it accounted for 7 percent, and the forecast for 1980 is less than 3 percent.

The subarea's total population, which was 900,000 in 1960, is projected to grow by about 18 percent in the 20-year period ending in 1980; the subarea will therefore come close to maintaining its share of the Basin's total population, even though it remains one of the least urbanized of the 19 subareas (32 percent urban in 1980).

SUBAREA H -- OHIO-HUNTINGTON

This subarea spans the mainstem of the Ohio River upstream and downstream from the Huntington-Ashland metropolitan complex. Agriculture continues to decline as a source of employment in this area, while manufacturing has shown considerable growth since World War II. Within the manufacturing sector, primary metals and chemicals account for the principal employment shares. Although primary metals (including the reduction of aluminum) is expected to continue as an important basic industry in this section of the valley, its labor requirement will decrease, so that by 1980 only half as many persons are likely to be employed in this activity as in 1960. Similarly the chemical industry will be capable of tripling its output in the subarea without requiring a larger working force, due to anticipated increases in productivity levels.

Even though the Huntington-Ashland SMSA accounts for almost half the subarea's population, the level of urbanization is considerably below that of the Ohio River Basin as a whole. Continued out-migration is likely to slow down the rate of population growth during the 1960's and 1970's.

SUBAREA I -- SCIOTO

This subarea, which lies entirely within Ohio, is roughly coextensive with the drainage area of the Scioto River. The Columbus SMSA is near its center. While employment in agriculture continues to decline, employment in manufacturing and in services can be expected to increase substantially. Within manufacturing, the area specializes in the metal fabricating, machinery, and transportation equipment industries, and all of these are likely to increase their employment during the projection period. The subarea enjoys excellent transportation facilities, is cen-

trally located with respect to its principal markets, and contains a rapidly growing urban center. The research and educational facilities of the Columbus area account for a substantial increase in service employment.

The subarea's population can be expected to grow by 40 percent between 1960 and 1980, and will thus increase its share of the Basin's population from less than 6 percent in 1960 to just under 7 percent in 1980.

SUBAREA J -- GUYANDOT-BIG SANDY-LITTLE SANDY

This subarea occupies the rugged uplands of southwestern West Virginia and eastern Kentucky. Its population is more than 90 percent rural, but the terrain is not suitable for agriculture. Mining dominates the area's economy; in 1960 it accounted for more than 37 percent of total employment, while manufacturing remained insignificant. Although mining is certain to decline as a source of employment (even while the output of the coal mines increases), it is likely to account for at least 20 percent of the working population in 1980, barring unforeseen changes in the markets for coal.

As out-migration continues to drain the population in the younger age groups, the rate of natural increase will undoubtedly continue to drop. We have projected an absolute decline in the subarea's total population from 464,000 in 1960 to about 400,000 in 1980.

SUBAREA K -- OHIO-CINCINNATI

This subarea occupies a section of the Ohio River valley which is dominated by the Cincinnati metropolitan area. In 1960 the SMSA accounted for more than 80 percent of the subarea's population. Also in 1960, manufacturing accounted for one-third of the subarea's total employment, with a heavy concentration of jobs in the production of durable goods, notably machinery and transportation equipment. In the future, manufacturing employment is not likely to grow much beyond the 1960 level due to anticipated increases in productivity. However, employment in the services, in finance and in the trades is likely to reflect the increasing importance of Cincinnati as a regional capital.

SUBAREA L -- LITTLE MIAMI-MIAMI

This subarea corresponds fairly accurately to the drainage area of the two tributaries which enter the Ohio River within the Cincinnati metropolitan area. A continuous belt of metropolitan counties extends along the valley of the Miami River. Hence this subarea is one of the most urbanized in the Ohio River Basin.

Manufacturing is the leading employment sector, accounting in 1960 for 38 percent of total employment. The subarea's specialization in machinery and transportation equipment cannot be matched by any other area in the Basin, and we foresee continued growth in these industry groups. The subarea's total population is projected to increase from about 1.4 million in 1960 to about 1.8 million in 1980, and will therefore enlarge its share of the Basin's total population from 7.5 percent in 1960 to about 8 percent in 1980.

SUBAREA M -- LICKING-KENTUCKY-SALT

This subarea, which lies entirely within Kentucky, encompasses the Blue Grass region around Lexington and also extends into the Appalachian uplands of eastern Kentucky. Agriculture has been the traditional mainstay of this area's economy; in 1930 agriculture accounted for 53 percent of total employment, and even though this share has been declining due to considerable improvements in productivity, it still accounted for over 21 percent of total employment in 1960. By 1980, however, manufacturing will have overtaken agriculture as a source of employment, with lumber and furniture, machinery, and apparel more than doubling their 1960 employment levels.

This subarea is not highly urbanized, and we expect the expansion of urban areas to be relatively modest until 1980. The total population of the subarea is projected to grow at a somewhat slower rate than the population of the Basin as a whole.

SUBAREA N -- OHIO-LOUISVILLE

This subarea comprises a section of the Ohio River valley centered on the Louisville metropolitan area. The Louisville SMSA, in 1960, accounted for 85 percent of the subarea's population. The growth of Louisville has been dramatic -- from 450,000 inhabitants in 1940 to 725,000 in 1960 -- and we expect further growth, though at a somewhat attenuated rate, between 1960 and 1980.

Manufacturing accounts for an increasing share of total employment -- 25 percent in 1940, 30 percent in 1960, and perhaps 32 percent in 1980. The manufacturing sector is quite diversified: machinery, lumber and furniture, tobacco, chemicals, and food production are important components of manufacturing in terms of employment. We expect this subarea to increase its population by almost 35 percent between 1960 and 1980, and thus to enlarge its share of the Ohio River Basin's total population.

SUBAREA O -- LOWER OHIO-EVANSVILLE

This subarea comprises the lower reaches of the Ohio River. Evansville is its major population center. The Evansville SMSA, which includes counties on both the Indiana and Kentucky sides of the river, accounts for 36 percent of the subarea's total population. About half of this population is still classified as rural, and there are significant portions of the floodplain that remain undeveloped.

In 1940, agriculture was still the largest employment sector in the subarea's economy; it accounted for 26 percent of total employment. By 1960, this share had decreased to less than 10 percent, while manufacturing had grown to 26 percent of total employment. Electrical machinery and furniture are the principal components of the manufacturing sector. Moreover, we expect the mining sector to increase its employment (contrary to the trend in other subareas) because of the anticipated demand for coal in electric power generation.

Although Evansville has not grown as rapidly as some other metropolitan areas in adjacent subareas, we have projected a subarea population increase of more than 25 percent for the two decades 1960-1980, a growth rate which slightly exceeds that of the Ohio River Basin as a whole.

SUBAREA P -- GREEN

This subarea, which is located entirely within Kentucky, is roughly coextensive with the drainage basin of the Green River. It is the smallest of the Ohio River Basin's subareas in terms of population and one of the least rapidly growing ones. Only 25 percent of the population is considered to be urban, and our projection indicates no significant increase in urbanization before 1980.

Agriculture has been the dominant sector of the economy: in 1940, almost 57 percent of the working population was engaged in agriculture; in 1960 this share had declined to 27 percent, and we expect it to fall to about 10 percent by 1980. In that year we expect manufacturing to account for 20 percent of total employment, with lumber and furniture, electrical machinery, and apparel considered the main growth areas.

SUBAREA Q -- WHITE

This subarea, which is located entirely within Indiana comprises the watershed of the White River, a tributary of the Wabash. Near its center lies the Indianapolis metropolitan area. Much of the subarea lies within what is known as the Corn Belt; it is thus one of the principal agricultural areas of the Ohio River Basin. Although agriculture has been contracting as a source of employment, it still accounted

for 6 percent of total subarea employment in 1960. However the manufacturing sector has grown rapidly in the postwar period and we expect that it will continue to account for more than 1/3 of all jobs in the subarea through 1980. Machinery and transportation equipment are the chief growth areas in manufacturing, but furniture, fabricated metals, food processing, chemicals, and printing also contribute to a dynamic and diversified manufacturing sector. Indianapolis is one of the major road hubs in the nation and the subarea enjoys proximity to the principal urban markets of the Middle West.

Between 1950 and 1960, the subarea's population increased by 20 percent; we have projected a 1960-1980 increase of more than 32 percent, which is considerably in excess of the projected growth rate for the Ohio River Basin as a whole. Thus the subarea can increase its share of the Basin-wide population from 9.4 percent (1960) to more than 10 percent (1980). It will also become increasingly urbanized; in 1980, almost 3 out of 4 subarea residents will be classified as urban.

SUBAREA R -- WABASH

This subarea, the westernmost of the Ohio River Basin, includes the Wabash and its western tributaries. It is equally divided in area between north-central Indiana and eastern Illinois. Most of its territory lies within the Corn Belt. Agriculture, though a rapidly shrinking source of employment, still accounts for 12 percent of the total working force. In contrast with other subareas, mining is an expanding sector which we expect to meet the increasing energy requirements of steam-electric generating plants. Manufacturing, too, is a growth sector, with machinery, transportation equipment, and chemicals expected to support a 30 percent increase in manufacturing employment between 1960 and 1980.

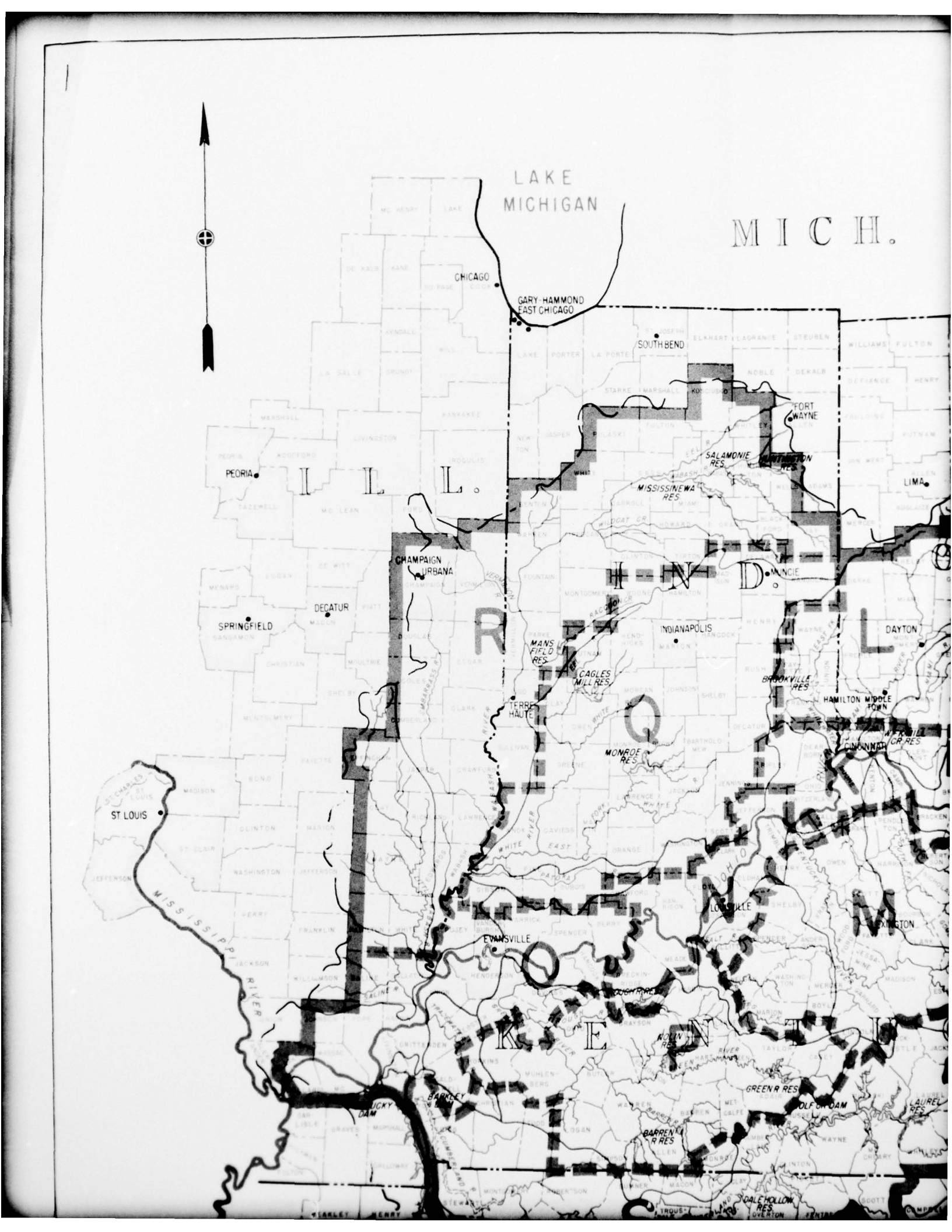
Although the subarea does not contain any of the Ohio River Basin's large metropolitan centers, it is expected to grow more rapidly, in terms of population, than the Basin as a whole. It enjoys excellent access to the Chicago metropolitan area and to the manufacturing centers surrounding the subarea.

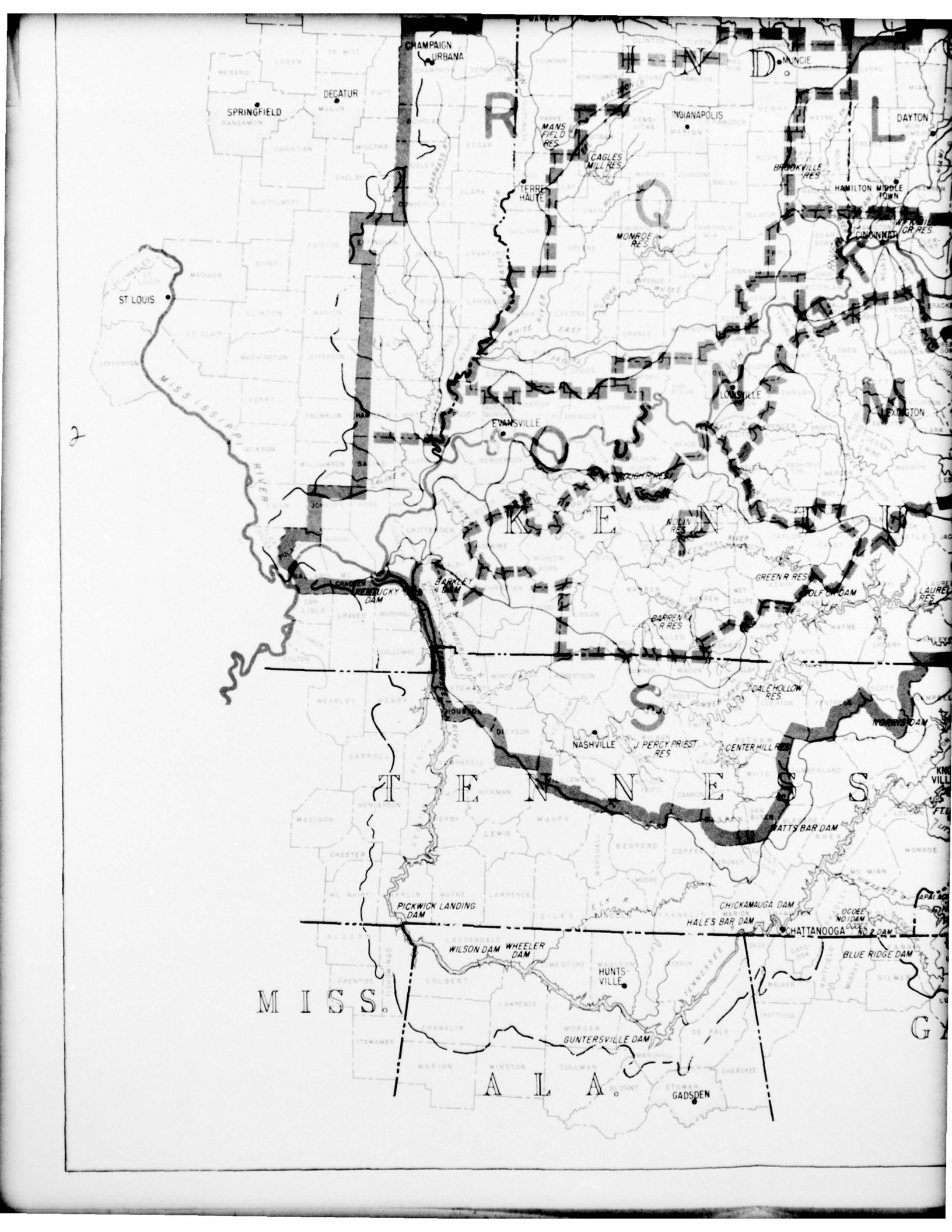
SUBAREA S -- CUMBERLAND

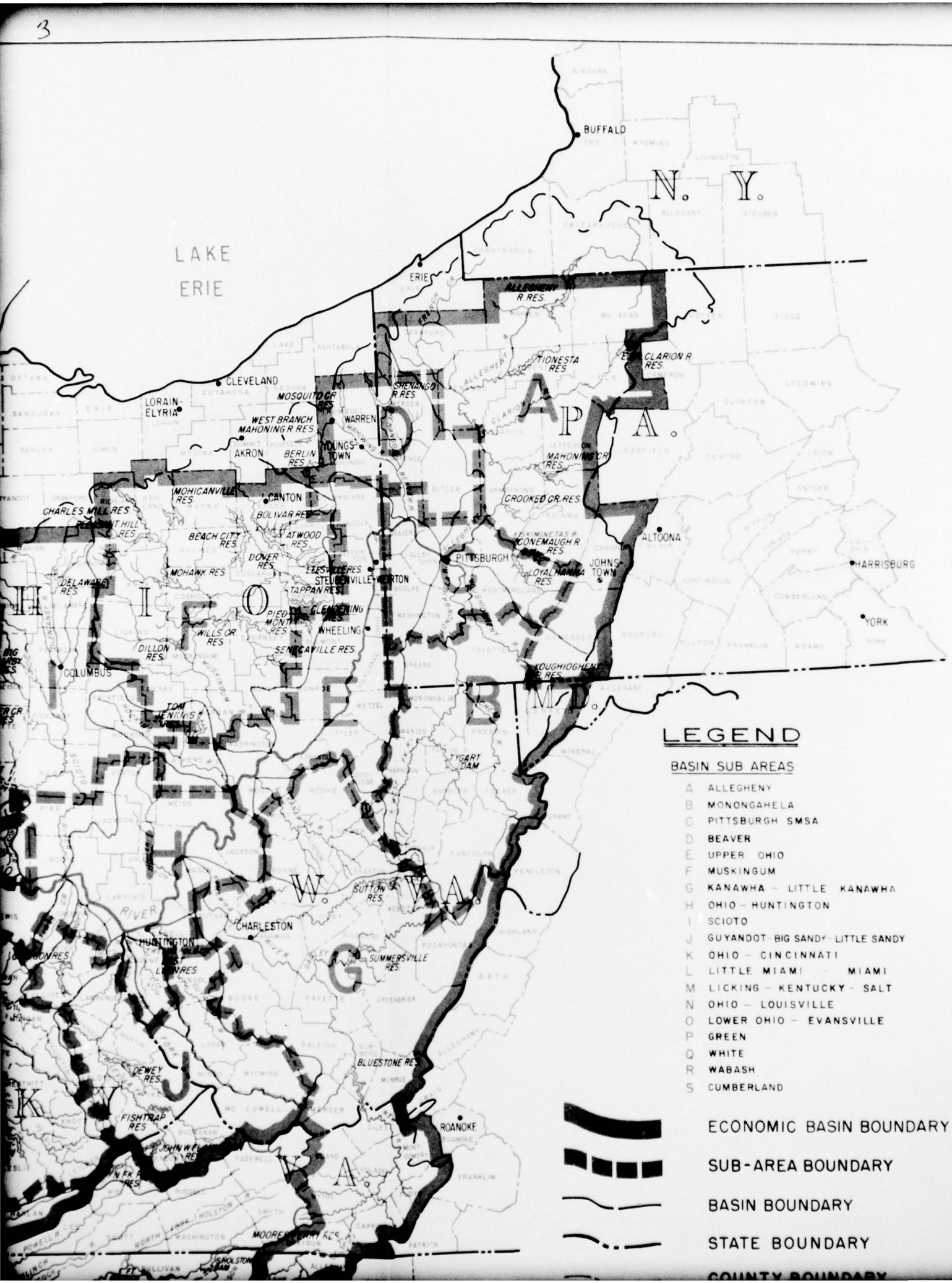
The southernmost of the subareas is virtually coextensive with the drainage basin of the Cumberland River which enters the Ohio just above the Tennessee. It contains the Nashville metropolitan area. During the postwar period, Davidson County, Tennessee (the Nashville SMSA), and three nearby counties have been the only ones in the subarea to experience significant population growth. In many counties within the Kentucky part of the subarea, the population has declined by 15 to 25 percent between 1950 and 1960.

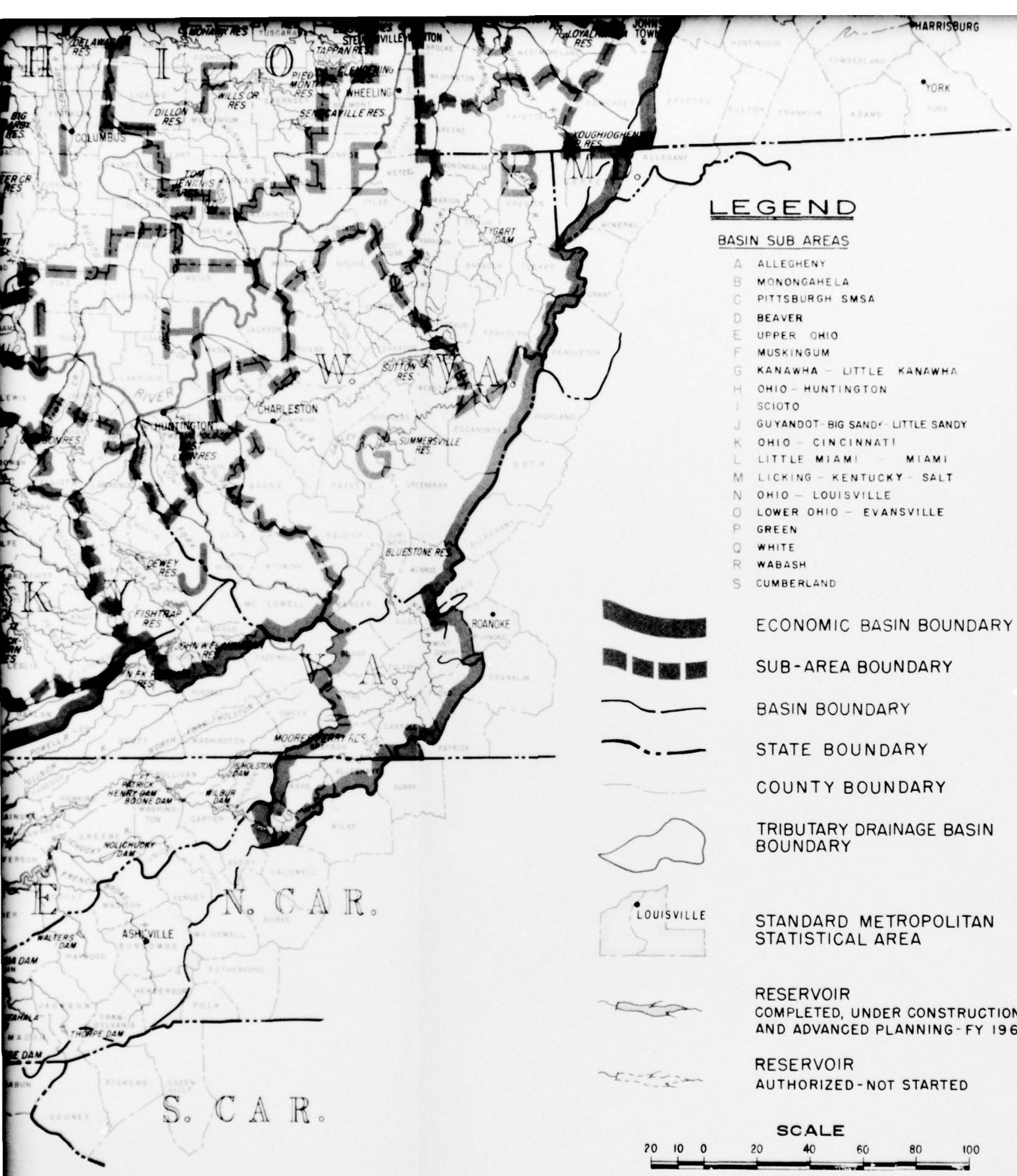
Until 1960, agriculture dominated the subarea's economy in terms of employment. In that year, however, both manufacturing and services accounted for a substantially larger share of total employment than agriculture. We have projected agricultural employment to decline to 5 percent of total employment by 1980, while manufacturing employment is expected to account for almost 25 percent of total employment. Apparel, lumber and furniture, and machinery are viewed as the strongest growth sectors.

Urbanization is growing fairly rapidly in this subarea. We expect at least 50 percent of the population to reside in urban areas by 1980. Despite the lack of growth in the postwar period, we have projected a population increase of more than 25 percent for the period 1960-1980. The availability of low-cost power is an important factor in stimulating the growth of manufacturing in this area.


LAKE
MICHIGAN
MICH.
CHICAGO
GARY-HAMMOND
EAST CHICAGO
SOUTH BEND
FORT
WAYNE
SALAMONIE
RES
HUNTINGTON
RES
MISSISSINEWA
RES
LIMA
PEORIA
ILL.
CHAMPAIGN
URBANA
MUNCIE
DECATUR
SPRINGFIELD
INDIANAPOLIS
DAYTON
MANS
FIELD
RES
CAGLES
MILL RES
BROOKVILLE
RES
HAMILTON
MIDDLE
TOWN
TERRE
HAUTE
MONROE
RES
CINCINNATI
ST LOUIS
MISSISSIPPI
RIVER
LOUISVILLE
EVANSVILLE
KENTUCKY
ROUGH R RES
ROUGH R
GREEN R RES
GREEN R
DAM
BARKLEY
DAM
BARREN R
RES
LAUREL
RES
DALE HOLLOW
RES


CHAMPAIGN URBANA
DECATUR
SPRINGFIELD
MUNCIE
INDIANAPOLIS
DAYTON
MANSFIELD RES
CAGLES MILL RES
TERRE HAUTE
BROOKVILLE RES
HAMILTON MIDDLETOWN
MONROE RES
ST LOUIS
MISSISSIPPI RIVER
LOUISVILLE
EVANSVILLE
LEXINGTON
ROUGH RIVER
KENTUCKY
NOLIN RES
GRAHAM
KENTUCKY DAM
BARKLEY DAM
GREEN R RES
BARREN R RES
LAUREL RES
DALE HOLLOW RES
NASHVILLE
J PERCY PRIEST RES
CENTER HILL RES
NORRIS DAM
TENNESSEE
WATTS BAR DAM
PICKWICK LANDING DAM
CHICKAMAUGA DAM
HALES BAR DAM
CHATTANOOGA
OCOEE NO 1 DAM
OCOEE NO 2 DAM
BLUE RIDGE DAM
WILSON DAM
WHEELER DAM
HUNTSVILLE
MISS.
GUNTERSVILLE DAM
ALA.
GADSDEN


BUFFALO
N. Y.
LAKE ERIE
ERIE
ALLEGHENY R RES.
TIONESTA RES
CLARION R RES
CLEVELAND
LORAIN-ELYRIA
MOSQUITO CR RES
SHENANGO R RES
WEST BRANCH MAHONING R RES
WARREN
AKRON
BERLIN RES
YOUNGSTOWN
MAHONING CR RES
PENNSYLVANIA
MOHICANVILLE RES
CANTON
CROOKED CR RES
CHARLES MILL RES
BOLIVAR RES
BEACH CITY RES
ATWOOD RES
DOVER RES
MOHAWK RES
CONEMAUGH R RES
ALTOONA
PITTSBURGH
JOHNSTOWN
LOYALHANNA RES
HARRISBURG
DELAWARE RES
LEESVILLE RES
STEUBENVILLE
WEIRTON
TAPPAN RES
OHIO
PIEDMONT RES
CLENDENING RES
WHEELING
YORK
WILLS CR RES
DILLON RES
SENECAVILLE RES
COLUMBUS
YOUGHIOGHENY R RES
MD.
TOM JENNINGS RES
TYGART DAM
W. VA.
SUTTON RES
CHARLESTON
HUNTINGTON
SUMMERSVILLE RES
BLUESTONE RES
DEWEY RES
KY.
FISHTRAP RES
ROANOKE
VA.
MOOREFIELD RES
LEGEND
BASIN SUB AREAS
A ALLEGHENY
B MONONGAHELA
C PITTSBURGH SMSA
D BEAVER
E UPPER OHIO
F MUSKINGUM
G KANAWHA - LITTLE KANAWHA
H OHIO - HUNTINGTON
I SCIOTO
J GUYANDOT - BIG SANDY - LITTLE SANDY
K OHIO - CINCINNATI
L LITTLE MIAMI - MIAMI
M LICKING - KENTUCKY - SALT
N OHIO - LOUISVILLE
O LOWER OHIO - EVANSVILLE
P GREEN
Q WHITE
R WABASH
S CUMBERLAND
ECONOMIC BASIN BOUNDARY
SUB-AREA BOUNDARY
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY



LEGEND

BASIN SUB AREAS

- A ALLEGHENY
- B MONONGAHELA
- C PITTSBURGH SMSA
- D BEAVER
- E UPPER OHIO
- F MUSKINGUM
- G KANAWHA – LITTLE KANAWHA
- H OHIO – HUNTINGTON
- I SCIOTO
- J GUYANDOT – BIG SANDY – LITTLE SANDY
- K OHIO – CINCINNATI
- L LITTLE MIAMI – MIAMI
- M LICKING – KENTUCKY – SALT
- N OHIO – LOUISVILLE
- O LOWER OHIO – EVANSVILLE
- P GREEN
- Q WHITE
- R WABASH
- S CUMBERLAND

ECONOMIC BASIN BOUNDARY

SUB-AREA BOUNDARY

BASIN BOUNDARY

STATE BOUNDARY

COUNTY BOUNDARY

TRIBUTARY DRAINAGE BASIN BOUNDARY

LOUISVILLE

STANDARD METROPOLITAN STATISTICAL AREA

RESERVOIR
COMPLETED, UNDER CONSTRUCTION, AND ADVANCED PLANNING - FY 1962

RESERVOIR
AUTHORIZED - NOT STARTED

SCALE

20 10 0 20 40 60 80 100

OHIO RIVER BASIN

U.S. ARMY ENGINEER DIVISION, OHIO RIVER
CINCINNATI, OHIO JUNE 1962